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THE Petroleum Engineer

NOVEMBER 1937

VOLUME IX NUMBER 2

A MAGAZINE OF METHODS FOR OPERATING MEN

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Meetings

California Natural Gasoline Association—December 2, Richfield Building, Los Angeles, California.

•

American Society of Mechanical Engineers—December 6, 7, 8, 9, and 10, New York, N. Y.

•

National Asphalt Conference—December 6, 7, 8, 9, 10, and 11, Memphis, Tennessee.

•

Society of Automotive Engineers, National Production Meeting—December 8, 9, and 10, Hotel Durant, Flint, Michigan.

•

Mid-Continent Oil and Gas Association, Annual Meeting of General Board of Directors—December 14, Tulsa, Oklahoma.

•

American Chemical Society, Division Organic Chemistry—December 28, 29, and 30, Richmond, Virginia.

•

American Society for Testing Materials, Spring Regional Meeting and Group Committee Meetings—March 7, 8, 9, 10, 11, and 12, 1938, Seneca Hotel, Rochester, New York.

•

American Association of Petroleum Geologists, 23rd Annual Meeting—March 16, 17, and 18, Roosevelt Hotel, New Orleans, Louisiana.

•

Petroleum Industry Electrical Association—April 13, 14, and 15, 1938, Rice Hotel, Houston, Texas.

•

American Chemical Society—April 17, 18, 19, 20, and 21, 1938, Dallas, Texas.

•

American Institute of Mining and Metallurgical Engineers, Open Hearth Conference—April 20, 21, and 22, Buffalo, New York.

•

International Petroleum Exposition—May 14, 15, 16, 17, 18, 19, 20, and 21, 1938, Tulsa, Oklahoma.

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The Course of Oil

By K. C. SCLATER

Forums, Praise, and Admonition

October and November have been rather hectic months for the oil industry. At Madison, Wisconsin, the court proceedings have been engaging the undivided attention of executives, who have been compelled to let many of their regular duties go by the board. But during the same period, the technical man and the practical man interested in operating practices and equipment in the various branches of the industry, have been catered to in full measure in an educational way.

Two meetings of the A.I.M.E., Petroleum Division, were held during October; one in Los Angeles, California, and the other in Oklahoma City, Oklahoma. During the week of the Oil-World Exposition at Houston last month, sessions were held daily and many interesting papers presented and discussed. The topics covered were principally for the edification of the man in the field and plant. A climax to this series of educational forums was the annual meeting of the American Petroleum Institute at Chicago, early in November.

Glancing through the titles of the papers, one is struck by the variety of topics and the many problems under attack of the type that are vital to progress. Not a few of these problems are in process of satisfactory solution. At the meetings of the A.P.I. in Chicago sincere efforts to face facts and a spirit of coöperation in overcoming harassing operating problems were evident to a greater degree than ever before—a rather healthy and encouraging sign for future technologic progress in the industry.

One of the highlights of October was Mr. Ickes' address before the annual convention of the I.P.A. at Houston. He paid the industry due praise in declaring that the State authorities and the oil industry have carried on a better job than could have been anticipated in managing its own affairs. He further stated, "the oil industry has recovered from the depressing conditions of 1933 and 1934 to such an extent that the emergency stabilization measures which were presented for consideration to the 74th Congress no longer press for attention."

Commenting on the conservation of the Nation's petroleum resources he said the Department of the Interior supports "the viewpoint of those who endeavor to gauge the reserves of oil in the United States and the withdrawals therefrom in comparison with the oil reserves of the rest of the world and the withdrawals therefrom." Those who do so "do not venture to predict whether there will be an oil scarcity or even a shortage in the United States, ten, twenty, or fifty years hence. They endeavor, rather, to formulate and establish a permanent oil policy for the United States that is based upon the simple objective that the United States should not exhaust its oil reserves before there is a corresponding shortage in other oil-producing countries. They agree that substitute products may be manufactured at higher costs from coal and shale but hold that the United States should not be forced to depend upon the more costly substitutes in advance of the rest of the world, nor pay higher prices for oil which will be demanded by foreign producers when the period of scarcity arrives.

"Although the search for oil has been more intensive in the United States than in foreign countries generally, the most favorable estimates credit the United States with less than half of the oil reserves of the world. We use in this country, principally from our own supply, about two-thirds of the oil consumed in the world. Simple arithmetic applied to this formula will reveal that we, in the United States, are using up our oil reserves at a faster rate than the rest of the world. Unless this trend is checked we will be faced with an oil shortage here in advance of a corresponding shortage abroad."

Regardless of whether or not one agrees with the foregoing viewpoint, the implied consequences are worth serious thought.

Aids from engineering are recognized. "The present disparity in oil resources between our country and the rest of the world can be corrected to some extent. American research, engineering, and management can make certain that our remaining oil reserves will be developed more efficiently and with a higher recovery factor than is common in oil-producing countries. Supplementing this, serious consideration can be given to the quantity and character of foreign oils which might be permitted to augment our domestic supply without affecting adversely our own oil industry."

Giving due credit for the elimination of many abuses and practices that in the past have led to wanton waste, attention is called to several practices leading to great waste of energy that still exist: "Those of you who have seen excessive flares burning in oilfields, have watched sub-surface pressures drop sharply so that energy has been dissipated without doing useful work, who know of the fictitious well-potentials, or are familiar with the practice of crediting to dead wells oil produced in other wells in order to establish an apparent conformance with State orders, are aware of some of the items in this record." These practices, thanks to the greater coöperation of operators, are gradually being stamped out.

Mr. Ickes sees great progress in the three years since he addressed the members of the American Petroleum Institute at Dallas. It is to be hoped that the next three years will see at least as much if not greater advancement, particularly with respect to the drilling of unnecessary wells in proven fields. This latter is one of the problems facing the industry and upon the solution of which, more than any one factor, depends the future stability of petroleum. It is a dark cloud on the otherwise bright economic horizon.

« « HIGHLIGHTS IN OILDOM » »

Supreme Court Upholds Commission on Spacing Rule

The Supreme Court of Texas, in a recent ruling, upheld the railroad commission in an important case involving interpretation of the state's well-spacing regulations. The court reversed a judgment of the Austin Court of Civil Appeals and affirmed one by the Travis County District Court refusing the Magnolia Petroleum Company's application for injunction against a permit to drill a well on a 1.6-acre tract in Gregg County granted by the commission to the Century Refining Company.

In making its ruling, the court stated that Rule 37, the well-spacing rule, has two distinct parts, the first dealing with a spacing pattern for the entire field and for wells generally, and the second with specific wells to be drilled as exceptions to the general rule. It was pointed out that the two parts have to be construed together to form the complete rule, and the legal effect is as follows:

"An applicant for a permit to drill a well not included within the general terms of the first part of the rule has the burden of showing a legal right thereto; having secured from the Railroad Commission an order granting a permit to drill, such order when issued is presumptively valid without a statute."

The general rule in the East Texas field, where the tract under consideration is situated, provides for spacing of wells not nearer than 330 ft. to a property line and 660 ft. between wells, or one well to ten acres. Most of the field has been drilled under exceptions to the rule.

The Civil Court of Appeals had held in effect that the commission, in adopting the general spacing rule, had implied that wells drilled at lesser distances would cause waste. In discussing this phase of the case, Assistant Attorney General Harry S. Pollard stated that if this opinion had been upheld the rule would have been destroyed and the legal basis for most of the wells in East Texas eliminated, that the courts would have been holding the rule was causing the waste. The commission contended the rule and the exceptions to it were preventing waste.

The Supreme Court also gave its opinion on the matter of subdividing tracts. It recognized that a subdivision could not create rights to a well on the subdivision, but likewise that a subdivision did not destroy the right that existed at the time of the subdivision.

There have been charges that some tracts were divided in efforts to obtain permits for more wells, and the courts have held that the owner of a tract was not entitled to such permits if the purpose of the subdivision was to circumvent the spacing rule.

In the case at hand the court considered the right of parties as they existed at the time of the subdivision, saying:

"Considering the situation of parties as it existed before any subdivision of property, and giving practical application and effect to the inherent right of a landowner to obtain his fair share of oil in place under his land, the permit in question should have been allowed."

Harbor Drilling Ordinances in Effect

Following several weeks of deliberations and postponments both the city of Long Beach, California, and the Harbor Board have passed drilling ordinances, which became effective November 11. Provisions of the two bills are identical and are as follows: (1) the drilling of more than one well per acre is prohibited; (2) a bond of $25,000 a well or $200,000 a lease is required; (3) a $750 permit fee is required, with an annual renewal fee of $150; and (4) surveys and other records shall be given to the Harbor Board.

●

Rules on Extension of Permits are Announced

Secretary of the Interior Harold Ickes has announced rules for extension of oil and gas prospecting permits under provisions of the 1937 law. He stated permits would be eligible for extension to December 31, 1939, only if they were outstanding on December 31 of this year, or if at that time they fell within one of the following classifications:

(1) Permits that have been committed in whole or in part to a co-operative or unit plan of development and operation, which on December 31, 1937, has been approved and prescribed by the secretary, or is in the process of revision or reconstruction.

(2) Permits that, together with one or more other permits, have been committed to a co-operative or unit plan of development and operation for all of an oil or gas pool or field (or reasonably compact area), if the plan was filed before January 1, 1937, and rejected pursuant to instruction of the secretary.

(3) Permits under which approved drilling was actively in progress at some time within the calendar year, 1937.

(4) Permits under which at least one well shall have been drilled to a depth of not less than 2000 ft. subsequent to August 21, 1935.

(5) Permits that have been issued subsequent to August 31, 1935, and for which timely compliance has been made with the drilling requirements of section 13 of the act of February 25, 1920, to the extent required by December 31, 1937, or, in the absence of such timely drilling, for which an acceptable co-operative or unit plan of development and operation has been filed on or before December 31, 1937.

Government officials say that permit holders who do not come under the new rules may retain their rights by applying for permission to exchange their permits for leases.

●

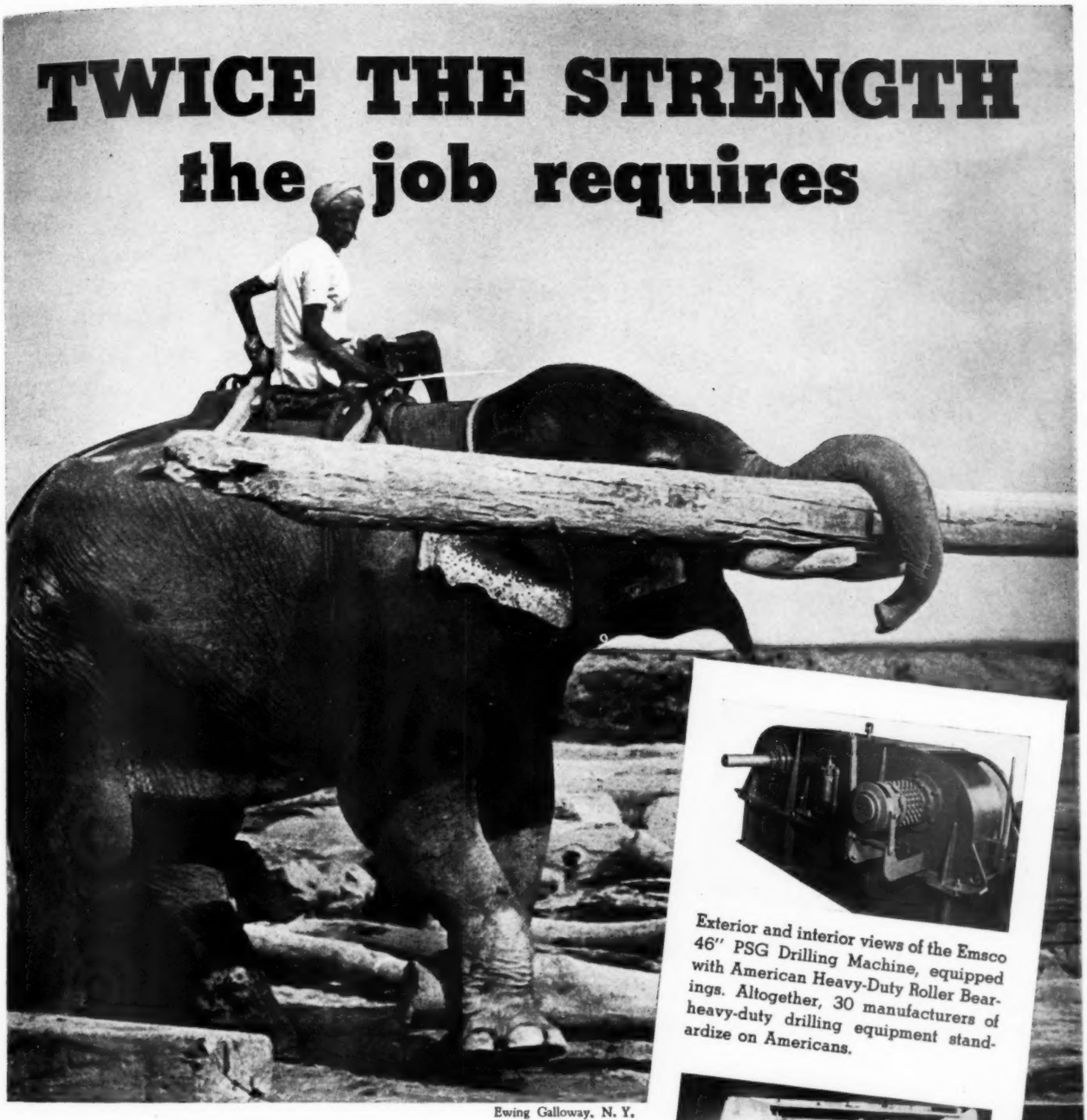
California Producer World's Second Deepest

The Union Oil Company of California has completed the second deepest producing oil well in the world. The well, No. 1-34 Kernco, four miles northwest of the Greeley field, extends the San Joaquin Valley area and may result in another major field.

The well was completed at a total depth of 11,302 ft., and initial production was 2400 bbl. of 39.6-gravity oil daily.

Although producing from a greater depth, No. 1-34

TWICE THE STRENGTH the job requires



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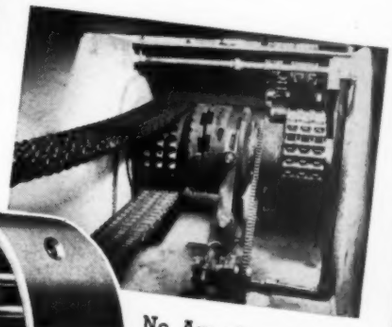

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Kernco is regarded as a continuation of the Greeley and Ten Section fields on a line southeast. Production is from a sand 55 ft. thick, supplying the only production in California from a depth below 11,000 feet.

●

Attack New Kansas Gas Law

The recently-enacted Kansas statute that prorates price and production of gas in the state has been challenged on the grounds of its constitutionality in a bill of complaint by the Ohio Oil Company recorded in the United States District Court at Wichita. Asking that the State Corporation Commission be enjoined from enforcing the law, the Ohio Oil Company alleges in its bill that the statute violates the due process clause of the fourteenth amendment, and the impairment of contracts clause of the federal consitution.

The bill attacks the Corporation Commission's orders for the months of September and October, which prorated gas production in the Otis field of Rush County, in which the Ohio Oil Company has six working leases. Through the proration, the company asserts it "stands to lose $50,000 a year," as it is limited to produce "only between one-third and one-half of our customers' requirements."

●

Lower Taxes on Oil Imports Will Be Opposed

Independent oil producers will oppose any attempt to lower excise taxes on oil imports as a result of the contemplated negotiations of a reciprocal trade agreement with Venezuela, notice of which has been given by the State Department, it is indicated. The department has invited proponents of changes in the tariff rates to submit not later than November 26 their data to the committee for reciprocation information, an adjunct of the United States Tariff Commission, upon which hearings will be held, and later the objectors to any change will be permitted to express their views.

It seems certain that any attempt to change the excise tax on oil and its derivatives will be opposed by the independent oil industry, which waged a long fight to place a tax embargo upon importations of foreign-produced oil, in the interest of the price structure of the American producer.

The excise or nuisance taxes were extended for a period of two years by act of the last Congress. This continued the import tax on crude oil of 21 cents a bbl.; gasoline, $1.05 a bbl.; fuel and gas oil, 21 cents a bbl.; and lubricating oil, 4 cents a gal. or $1.68 a barrel.

●

Eight Defendants Freed of Oil Conspiracy Charge

Judge Patrick Stone, before whom the oil conspiracy case is being tried in Madison, on November 11 dismissed the complaints against seven defendant corporations and one individual, freeing them of the government's charge. Charges against the following were dismissed: The Tide Water Associated Oil Company, Deep Rock Oil Corporation, Louisiana Oil Refining Company, Cities Service Export Oil Company, Chicago Journal of Commerce Publishing Company, Platt's Oilgram, National Petroleum News, and Warren Platt of Cleveland, Ohio, publisher of the latter two publications.

Dismissal of complaints against these defendants was made on motion of the government's counsel, who felt that the evidence against them did not justify presentation of their case to the jury. In moving for dismissal of charges against the eight defendants, Prosecutor Chaffetz explained that the government felt it had not "adduced sufficient evidence" to hold the trade journal. Questions of corporate entities entered into the dismissal of charges against the four oil companies. All evidence regarding the Tide Water companies showed that Tide Water Associated was a holding company during the period of the alleged conspiracy and that its directors knew nothing of any gasoline purchasing.

Cities Service Export Oil Company since has been merged with other Cities Service companies, Chaffetz said. Louisiana Oil Refining Company no longer is in existence, and Deep Rock was being operated by federal court trustees at the time and so could not be held liable.

Still on trial are 21 defendant corporations and 47 individual defendants, charged by the government with engaging in a price-fixing conspiracy in violation of the Sherman Anti-trust Act.

●

Indications of Petroleum in Bulgaria

Interest in petroleum surveys is growing in Bulgaria, there being numerous geological and other indications of the existence of petroleum deposits. Theoretically it is supposed that the northeastern part of Bulgaria is a continuation of the Rumanian oil fields, and that the southeastern part is a continuation of the Caucasian mountain range. There are, however, indications of the existence of petroleum in some western parts of Bulgaria. So far, however, no definite results of a practical nature have been obtained, the surveys being not quite thorough and the soundings not having exceeded a depth of some 400 meters.

●

Search for Oil Near Edinburgh, Scotland

A serious search for oil now is being made at Cousland, two miles southeast of Dalkeith, Scotland, approximately six miles from Edinburgh. The oil-drilling operations, which began on September 6, 1937, are being made by the D'Arcy Exploration Company, Ltd., a subsidiary of the Anglo-Iranian Oil Company, Ltd.

For drilling purposes a 94-ft. derrick was erected, its steel foundation embedded in concrete. Two Diesel engines were installed. Drilling is being carried on in three eight-hour shifts, and it is planned to go to a depth of 4000 feet. At the present time there is a staff of 45 men, including three skilled drillers from Iran (Persia); and a resident geologist has been engaged to examine the various structures found.

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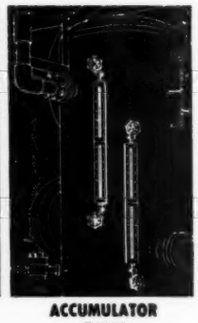

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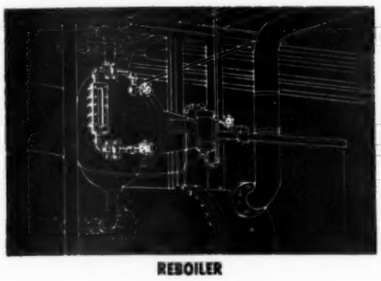
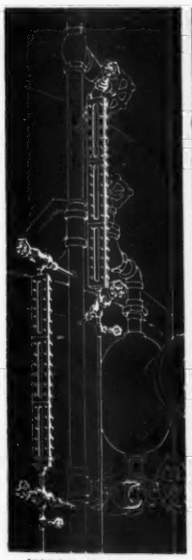
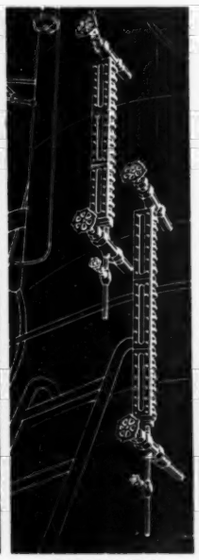


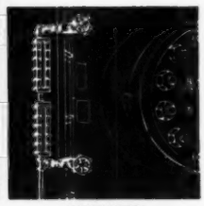
REBOILER



VAPOR SEPARATOR



CRACKING STILL



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● The sketches show only a few of the many important applications for Penberthy Reflex Gages in oil refineries and natural gasoline plants. As a matter of fact, Penberthy Reflex Gages are preferred wherever a liquid level must be easily and positively visible . . . when that liquid is under pressure or at high temperature (or both).

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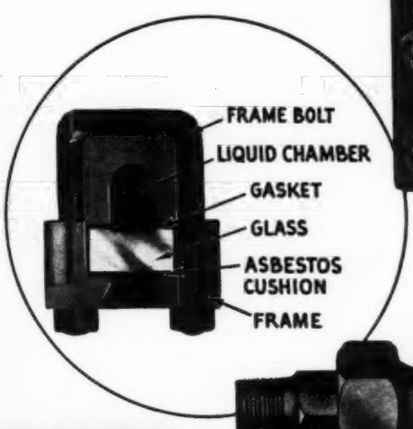

MULTIPLE TYPE EQUIPPED WITH DROP FORGED STEEL GAGE VALVES

PENBERTHY PRODUCTS

PENBERTHY INJECTOR COMPANY *Manufacturers of* QUALITY PRODUCTS *Since 1886*
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Latest Activities In The Oil Fields

DEEP production in the Kemp City (KMA) field of Wichita County, Texas, has been extended in three directions by wells completed within the past two weeks. Hammon, Hanlon-Buchanan's No. 1 Fassett and Tuttle, four and one-half miles northeast of production, flowed over the mast after shooting the sand encountered at 3998 to 4014 feet. Melat and Graham's (Stump) No. 1 Waggoner Brothers flowed by heads after 15 ft. of sand topped at 3935 ft. was shot. This well is three and one-half miles northwest of production. Kadane et al's No. 1 C. Mangold, one mile west of production, flowed into the pits after drilling sandy lime from 3700 to 3726 feet. The field is as yet undefined except on the southeast.

●

Continental Oil Company's No. 1 Brookshire on the Abbeville prospect in Vermilion Parish, Louisiana, opened a new field when it flowed 500 bbl. daily from sand at a depth of 7845 to 7890 feet. Total depth of the well is 11,909 feet.

●

A new producing area in Columbia County, Arkansas, was opened by Standard Oil Company of Louisiana's No. 1 McKean. The well produced 158 bbl. of 32-gravity oil in a 12-hr. test through ½-in. choke, and is completed in the Permian limestone at a total depth of 7204 feet.

●

National Refining Company's No. 1 Fee in SE NE SE of 36-27-2e, nine miles east of Wichita in Sedgwick County, Kansas, produced an estimated 500 bbl. of 30-gravity oil from the Wilcox sand after penetrating it 12 feet. Total depth of the well is 3099 feet. Nearest production is the Eastborough pool, six miles northeast of the wildcat producer.

●

The Denver pool in southern Yoakum County, Texas, was extended a mile and a half northeast by the American Liberty Oil Company's No. 1 Clawater, which flowed after acid treatment of porous lime. Total depth of the well is 5083 feet.

●

The Texas Company's No. 1-L State, in 1-18s-34e, southwest of Lovington in Lea County, New Mexico, gauged 184 bbl. of oil in 12 hours. The well is three miles south of the Vacuum area. It was drilling in lime below 4365 feet.

●

A new field or a three-mile southeast extension of the Greeley field, Kern County, California, was indicated by the flow of oil in the Superior Oil Company's No. 9 K. C. L. in 3-30-26w, which was estimated to be at the rate of 1500 or 2000 bbl. daily through 1-in. bean. After the test the well was cored deeper. The test was made at a total depth of 7605 feet.

●

In Hughes County, Oklahoma, Phillips Petroleum Company's No. 1 Becker, NE NW SW 8-5-10, showed an increased gas flow of 21,000,000 cu. ft. and flowed ten bbl. of oil in 12 hours after coring an additional seven ft. of Cromwell sand. The company plans to core deeper.

●

Duncan Oil Company's No. 1 Mrs. J. W. Riggs in 27-2n-8e, Wayne County, Illinois, blew out while making a drill stem test and sprayed oil over the derrick and caught fire. The well is two miles southeast of production in the Clay City township field of Clay County.

●

Three miles southeast of the Gates pool, Stafford County, Kansas, and in the northeast-southwest trend with the new Sittner pool, Rust and Nadel's No. 1 Drach, NE NE SW 12-22-13w, produced 135 bbl. of oil in a three-hour test. Production of 35.2-gravity oil is obtained from the Siliceous lime at a depth of 3693 to 3705 feet.

AVERAGE CRUDE PRICES

California	
Kettleman Hills	$1.19-1.43
Playa Del Rey	.80-1.16
Coalinga	.70- .90
Signal Hill	.80-1.21
Montana	1.35
Wyoming	.97-1.30
Colorado	1.12-1.18
New Mexico	.78-1.08
Texas	
North Central	.96-1.20
Panhandle	.91-1.08
West Texas	.78-1.08
Gulf Coast	.95-1.41
Darst Creek	1.09
East Texas	1.35
Talco	.73
Kansas	.98-1.30
Oklahoma	.98-1.30
Arkansas	.90
Louisiana	
Rodessa	$ .91-1.25
Gulf Coast	.84-1.41
North Louisiana	.90-1.22
Illinois	1.35
Kentucky	1.40
Indiana	1.12
Ohio	
Lima	1.25
Michigan	1.27
Pennsylvania	
Bradford	2.35
Southwest	2.05
Eureka	2.00
Buckeye	1.85
Corning	1.27
West Virginia	1.67
Canada	2.10-2.17

DAILY AVERAGE CRUDE OIL PRODUCTION

Data Supplied by A.P.I.

(Figures in Barrels)

	B. of M. Dept. of Int. Calculations (Oct.)	Week Ended Oct. 30, 1937	Week Ended Sept. 4, 1937	Week Ended Oct. 31, 1936
Oklahoma	629,200	586,750	639,500	564,750
Kansas	199,900	185,600	192,550	163,400
Panhandle Texas	.....	79,000	80,150	65,950
North Texas	.....	73,200	74,850	65,300
West Central Texas	.....	34,700	33,800	33,800
West Texas	.....	217,350	232,850	170,100
East Central Texas	.....	110,200	127,450	71,100
East Texas	.....	482,950	474,450	439,650
Southwest Texas	.....	268,500	264,700	169,950
Coastal Texas	.....	204,900	221,750	178,100
TOTAL TEXAS	1,430,300	1,470,800	1,510,000	1,193,950
North Louisiana	.....	76,250	88,950	75,450
Coastal Louisiana	.....	167,750	176,150	157,800
TOTAL LA.	254,600	244,000	265,100	233,250
Arkansas	36,000	48,650	36,300	28,100
Eastern	128,800	133,300	140,800	117,050
Michigan	43,500	54,300	48,550	31,200
Wyoming	57,300	57,400	54,200	40,400
Montana	17,600	17,650	17,850	15,750
Colorado	4,500	4,150	4,800	4,950
New Mexico	106,400	103,350	114,200	83,100
TOTAL EAST OF CALIF.	2,908,100	2,905,950	3,023,850	2,475,900
California	660,000	697,000	668,700	567,600
TOTAL U. S.	3,568,100	3,602,950	3,692,550	3,043,500

GIVE a power-crew of "Caterpillar" Diesel Engines a chance to team up on a big job and they'll tear through old Mother Earth "like nobody's business." Built for endurance, they're gluttons for ceaseless day-and-night going—making every minute count toward reaching the "liquid gold." Designed for thrift, they go along on a fuel-consumption that makes power-cost a rational thing instead of a headache.

For instance: All four "Caterpillar" Diesels—totaling 570 hp.—on this deep-drilling operation, near Crosby, Texas, use only about 300 gallons of 6c Diesel fuel per 24-hour day; or 12½ gallons per hour. Figure it out in dollars-per-day . . . consider the added cost of lubricating-oil and maintenance . . . compare the total operating-cost of $1.40 per hour for these 4 engines with the cost of other types of power.

The universal use of Diesel power for drilling, line-pumping and other oil-field uses is inevitable—since nothing else compares with it in cheapness and dependability. The time to begin thinking about it is NOW. "Caterpillar" dealers have definite facts-and-figures that will interest you. Or, write us direct.

SEVEN ENGINE SIZES—44 TO 160 HP.

OIL-RIG of H. J. DeArman, Houston, Texas. The two D17000 "Caterpillar" Diesel Engines operate 18-inch pump and draw-works through friction-type clutch. The two D13000 engines drive a 16-inch mud-pump. At time of photo, hole was down 2800 feet—with about 4200 more feet to go. Mr. DeArman has standardized on "Caterpillar" Diesel power.

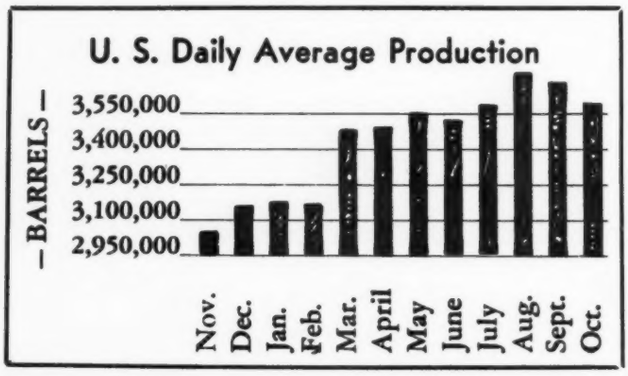
CATERPILLAR DIESEL ENGINES

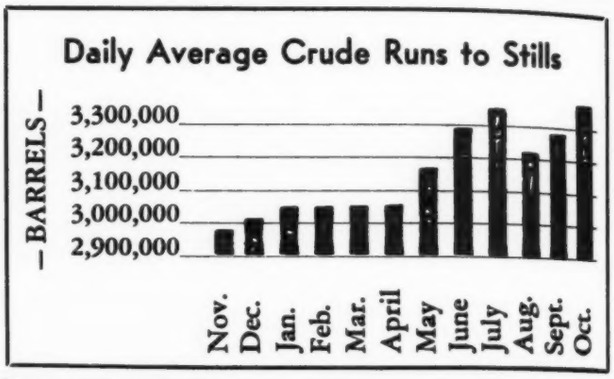
REG. U. S. PAT. OFF.

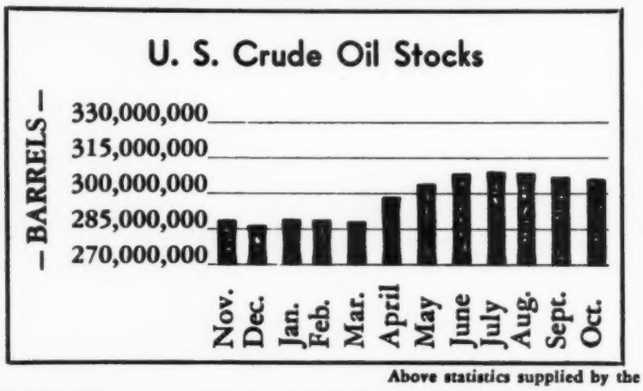
CATERPILLAR TRACTOR CO., PEORIA, ILL.

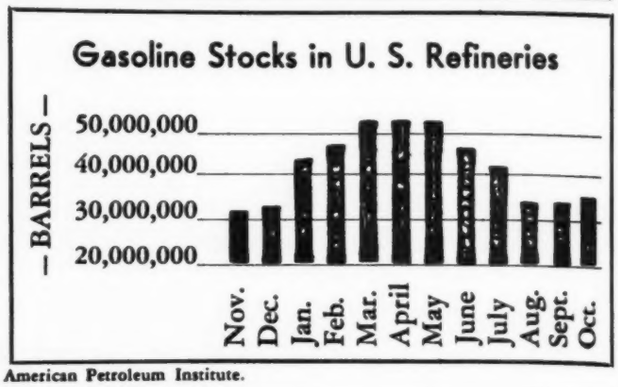
WORLD'S LARGEST MANUFACTURER OF DIESEL ENGINES

Summary of Petroleum Statistics and Field Activities









Above statistics supplied by the American Petroleum Institute.

Summarized Operations in Active Fields for October, 1937

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas								
East Texas	280	268	56	100	3500-3700	2	40	Rotary
Duval County	71	57	19	58	1554-2900	2	22	Rotary
Archer County	24	9	2	9	660-1800	1 or 2	40	Rot.-Cab.
Panhandle	107	102	60	185	1700-3900	2	40	Rotary
Refugio County	20	19	4	14	4900-5900	2	38	Rotary
Nueces County	37	34	19	57	3922-5878	2 or 3	21-54	Rotary
Winkler County	51	51	10	49	2850-3450	2 and 3	30-38	Rot.-Cab.
Talco Field	43	42	5	31	4230-4361	2	16-24	Rotary
Oklahoma								
Oklahoma City	8	7	1	6	6450-6682	3	39	Rotary
Fitts Pool	50	47	6	33	1800-4488	2 or 3	38	Rotary
Osage County	21	14	3	26	380-2850	2	37.5-40	Rot.-Cab.
Kansas								
Russell County	53	50	12	53	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	33	29	8	39	3222-4085	2 and 5	42-48	Rot.-Cab.
Reno County	6	6	2	11	3300-4375	2 and 5	42-48	Rot.-Cab.
Louisiana-Texas-Arkansas								
Rodessa	30	28	16	61	5950-6450	3	39	Rotary
New Mexico								
Lea County	59	46	23	120	3150-4030	3	30-34	Rot.-Cab.
California								
Kettleman Hills	1	1	1	12	8300-8730	3 or 4	40	Rotary
Wilmington	30	29	6	29	3500-4000	2 and 3	18-20	Rotary

Field Activities by States for October, 1937

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1936 (In Barrels)
	October	September	October	September	October	September	October	September	October	September	
Arkansas	19	15	15	11	27	32	19	21	62	66	10,461,000
California	150	124	128	100	169	130	140	110	249	251	214,883,000
Colorado	6	7	0	2	....	....	2	2	37	40	1,670,000
Illinois	96	74	62	46	....	....	....	....	....	....	4,452,000
Indiana	15	6	7	5	....	....	2	2	28	24	795,000
Kansas	298	255	236	198	303	273	74	76	429	435	58,226,000
Kentucky	105	73	66	46	....	....	15	16	84	79	5,653,000
Louisiana	96	111	76	90	129	134	47	53	267	278	79,980,000
Michigan	100	104	72	74	99	82	60	65	175	165	11,852,000
Mississippi	....	1	....	1	....	....	5	4	12	13	Gas Prod.
Montana	28	23	26	18	....	....	5	5	71	72	5,632,000
New Mexico	67	63	60	59	....	....	28	32	161	170	27,134,000
New York	....	....	....	....	....	....	....	....	....	....	4,637,000
Ohio	144	146	102	104	....	....	68	65	221	214	3,834,000
Oklahoma	254	203	194	154	214	217	53	59	392	424	206,082,000
Pennsylvania	....	....	....	....	....	....	....	....	....	....	15,830,000
Texas	1516	1405	1237	1142	1625	1526	471	491	1741	1762	391,097,000
West Virginia	100	93	82	81	....	....	37	38	202	201	3,903,000
Wyoming	10	8	6	6	....	....	10	12	69	71	13,650,000
Total	3004	2711	2369	2137	2566	2394	1036	1051	4200	4285	993,942,000

Among new Dowell developments is the compound treatment bringing the production boosting benefits of *Inhibited* Acidizing to tight and impure formations. Once again Dowell demonstrates its ability to meet unusual conditions by devising special methods and technique.

Among the interesting methods of American oil production were the efforts of Roy L. Jones and E. M. Carter, of Wichita Falls to mine oil at Electra, Texas in 1925. Sinking a shaft 108 feet to the top of the sand body, a drift was driven some 15 feet. The shaft was then deepened another 20 feet and a second drift of 60 feet run under the pay. Daily production averaged 60 barrels. Unprofitable in comparison with present low cost drilling, this experiment proved the possibility of mining as a secondary recovery method in shallow pays.

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*Registered U. S. Patent Office

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OIL AND GAS WELL CHEMICAL SERVICE

Progress of Major Pipe Line Work

THE Pure Oil Company's new combination 10-in. and 14-in. pipe line, having a daily capacity of 40,000 bbl., has been completed in Illinois. The line is 45 miles in length and extends from a point approximately one mile east of Noble, Richland County, to the company's tank farm at Martinsville where it connects with the trunk line of the Illinois Pipe Line Company. The new line was laid for the purpose of transporting production of the Pure Oil Company from the new fields in Illinois to the company's refineries. The Illinois Commerce Commission recently approved the making of contracts with the Illinois Pipe Line Company to carry crude to Pure Oil Company refineries in Ohio.

●

At Wayside Halt, near Yserplaatsvlei, in Cape Colony, Union of South Africa, an oil depot having a capacity of 200,000 tons is being constructed. It will be the largest oil depot in the Union of South Africa. Pipe lines will be laid from the depot to the Cape ports. Several major oil companies are helping to finance the project, but the South African railways are the principal backers.

●

To provide more gas for winter demands the Cities Service Gas Company has completed several construction projects. One was the laying of 47 miles of 12-in. gas line from the Seminole, Oklahoma, 16-in. main line to the Fitts field. Another was the construction of eight and one-half miles of 10-in. pipe line from the Oklahoma City 20-in. to the Edmond field. The Lyons, Kansas, treating plant and field gathering system also have been completed and placed in operation. This plant was constructed to treat sour gas in the Lyons area to make it commercially usable. Two field compressor stations of 230 hp. each, together with the necessary gathering lines, have been constructed in the Pampa, Texas, area. The stations are used to boost gas from the low-pressure wells into the intake lines so that well deliveries will be prorated evenly over the area.

The company also is installing at Pampa a dehydration plant to remove moisture from the gas before it goes to the trunk lines. Heretofore the capacity of the 20-in. line between Pampa and Wichita has been greatly reduced by the formation of ice and the accumulation of moisture. Installation of this dehydration unit will tend to correct the condition and make it possible to handle more gas during cold weather.

●

The Keystone Pipe Line Company and the Buffalo Pipe Line Company, subsidiaries of the Atlantic Refining Company, have completed and placed in operation a 225-mile gasoline line in Pennsylvania and New York State. Details of the laying of the line are given in a special article beginning on page 58 of this issue of *The Petroleum Engineer*.

●

The Bay Pipeline Company, organized by a group of independent oil operators, is laying a 33-mile oil line from the Buckeye Township fields, Gladwin County, Michigan, to Bay City, where, according to present plans, a refinery is to be constructed. The same group, operating as the Bay Refinery Company, will erect the refinery, which will have a daily capacity of 3000 barrels.

●

The Commonwealth Pipe Line Company has been organized with the approval of the Michigan Securities Commission. The chief incorporators, a group of operators in the Salem field, Allegan County, are: Allegan Crude Oil Company, Lentz and Miller, Inc., and Muskegon Oil Corporation, all of Muskegon, Michigan.

●

If the city council of Lusk, Wyoming, acts favorably upon the application of the Rocky Mountain Gas Company, subsidiary of the Ohio Oil Company, for a 50-year franchise to supply natural gas to the town of Lusk, a 22½-mile pipe line will be laid to the Lance Creek field. Dry gas would be boosted to the city from the Ohio Oil Company's absorption gasoline plant in the field.

●

Early in November the Standard Oil Company of Louisiana, Pipe Line Department, completed its combination 6-in., 8-in., and 10-in. pipe line system that connects the Roanoke and Jeanerette fields of South Louisiana with the Standard refinery at Baton Rouge. Approximately 150 miles of pipe line were laid and pump stations were constructed at Roanoke, Jeanerette, and Sunset. Complete construction details will be found in a special article beginning on page 48 of this issue of *The Petroleum Engineer*.

●

The Caddo Pipe Line Corporation, subsidiary of the Grogan Oil Company, has completed its 6-in. oil pipe line from the Lisbon field to a point near Homer, Louisiana, a distance of 18 miles. At the latter point the line connects with the Haynesville-Shreveport trunk system of the Arkansas Fuel Oil Company. The Caddo Pipe Line Company is taking approximately 7000 bbl. of crude daily.

●

The newly-organized Alamo Pipe Line Company, headed by E. M. Jones of San Antonio, Texas, has completed the laying of a pipe line from the Ezzell field of McMullen and Live Oak counties to Kittie. At the latter point the crude is loaded into tank cars.

●

The Gas Corporation of Michigan has filed a petition with the Michigan Public Utilities Commission for permission to contract with the Consumers Power Company for needed gas, to organize a pipe line company, and to issue bonds to cover the cost of constructing and operating a pipe line. If these requests are granted a 13-mile line will be laid to connect the Gas Corporation of Michigan with the line of the Consumers Power Company from the Broomfield gas area. The purpose of the project is to alleviate a gas shortage at Mt. Pleasant and Clare.

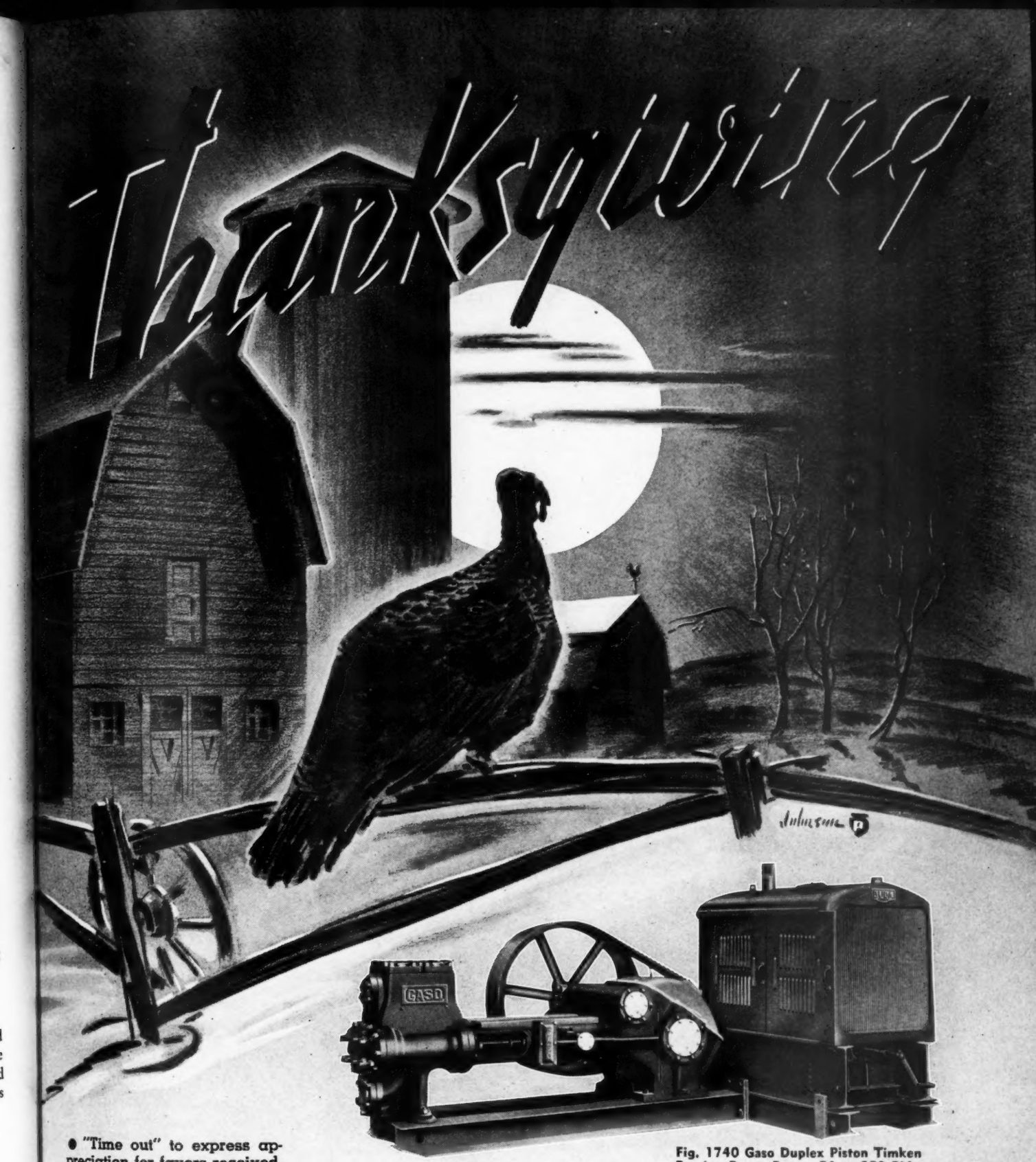

Fig. 1740 Gaso Duplex Piston Timken Bearing Power Pump, 54 to 250 Bbls.

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Complete Gaso Condensed Catalog, in 1937 Composite Catalog

GASO PUMPS

for every oil industry need

The Month's Activities In Refining

Percent Refinery Capacity Operated

Western Division, 75.9 Percent **Central Division, 79.5 Percent** **Eastern Division, 82.2 Percent**

THE Continental Oil Company has had in progress for some time a program of expansion and reconditioning to its various refining facilities. Some of this work already has been completed. Of greatest importance has been the complete rebuilding of the company's Baltimore refinery, which now has a capacity of approximately 8500 bbl. daily. This work included the installation of new stills, and the erection of a new refinery office building. The plant is obtaining its crude supply from the Tepetate field of South Louisiana, being transported by pipe line to Lake Charles, where it is loaded into tankers and shipped to Baltimore. In this connection, the company's terminal at Lake Charles is being enlarged. At Ponca City, Oklahoma, executive headquarters of the company, several units of the refinery have been enlarged and remodeled, and the refinery office building air-conditioned. The Continental's Denver, Colorado, refinery, which obtains its crude from Wyoming and Colorado fields, is having its capacity doubled by the addition of processing equipment. At Artesia, New Mexico, the company's skimming plant has been converted into a modern cracking unit.

●

The Barnsdall Oil Company has announced its intention of constructing a natural gasoline plant in the Foster pool of Ector County, Texas. It also will receive gas from the Harper pool west of the Foster area, the total capacity of the plant being 8,000,000 cu. ft. daily.

●

The Humble Oil and Refining Company plans to construct a natural gasoline plant of the well-pressure type in the Heyser field, Calhoun County, Texas. It will be situated on the company's P. H. Welder "B" lease.

●

Harry Pace and John Ward of Shamrock, Texas, have acquired the Mid-West Refining Company's refinery situated approximately eight miles southeast of Shamrock in Wheeler County, Texas, and will operate it under the name of the Paward Refining Company. The daily capacity of the plant is 750 barrels.

●

The North Caddo Refining Company's plant, on the Louisiana side of the Rodessa field, which was partially destroyed recently, has been rebuilt and enlarged. The capacity has been increased from 750 bbl. daily to 1500 barrels.

●

The Globe Oil and Refining Company has shut down its refinery at Blackwell, Oklahoma. For the last several months the plant has been processing 5000 bbl. of crude daily. The capacity of the refinery is 8000 bbl. daily.

●

Work is well underway on the high-pressure absorption gasoline plant being constructed in Marion County, Texas, by the Arkansas Fuel Oil Company. The plant is situated about midway of the county's two Trinity series oil-producing districts along the Rodessa fault. The plant, first to be erected in the county since mile-deep production was found last February, and second in the Texas portion of the Rodessa field, is in the southern part of the John Hanks survey, southwest of the Lodi district. Officials say the plant will have a capacity of 25,000,000 cu. ft. of gas daily.

●

A small refinery of 200-bbl. daily capacity is being planned for Red Deer, Alberta, Canada. P. L. Hyde of Calgary, and Red Deer interests, are behind the project. The plant is expected to be completed by March, the output to be marketed largely in the Red Deer area.

●

The Rancho Gasoline Company has completed and started operating its new gasoline plant at Tejon Ranch, California. Gas supply is obtained from the Reserve Oil and Gas Company. Capacity of the plant is 20,000,000 cu. ft. daily.

●

A new stabilizer has been installed in the Rodessa, Louisiana, gasoline plant of the Arkansas Fuel Oil Company. The plant now has a daily capacity of 100,000,000 cu. feet.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks

Week Ended October 30, 1937

A.P.I. Figures

(Figures in Barrels of 42 Gal. Each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	526,000	78.6	18,220	15,258
Appalachian	88.4	91,000	70.5	2,564	926
Ind., Ill., Ky.	92.4	477,000	97.5	10,279	7,410
Okla., Kans., Mo.	84.7	279,000	72.8	6,155	3,902
Inland Texas	56.6	143,000	71.1	1,936	1,925
Texas Gulf	95.7	725,000	91.0	8,119	11,732
La. Gulf	96.6	134,000	79.8	1,838	3,639
No. La.-Ark.	63.7	48,000	82.8	373	464
Rocky Mt.	69.7	47,000	75.8	1,324	673
California	90.9	568,000	76.1	12,408	71,791
Reported	89.0	3,038,000	82.1	63,216	117,720
Est'd Unreported	.....	307,000	.....	3,620	3,350
*EST'D TOTAL U.S. Oct. 30, '37	.....	3,345,000	.....	66,836	121,070
*EST'D TOTAL U.S. Oct. 23, '37	.....	3,380,000	.....	66,554	119,634
U. S. B. of M. *Oct. 30, 1936	.....	**3,005,000	.....	57,666	112,930

*Estimated Bureau of Mines' basis.

**October, 1936, daily average.

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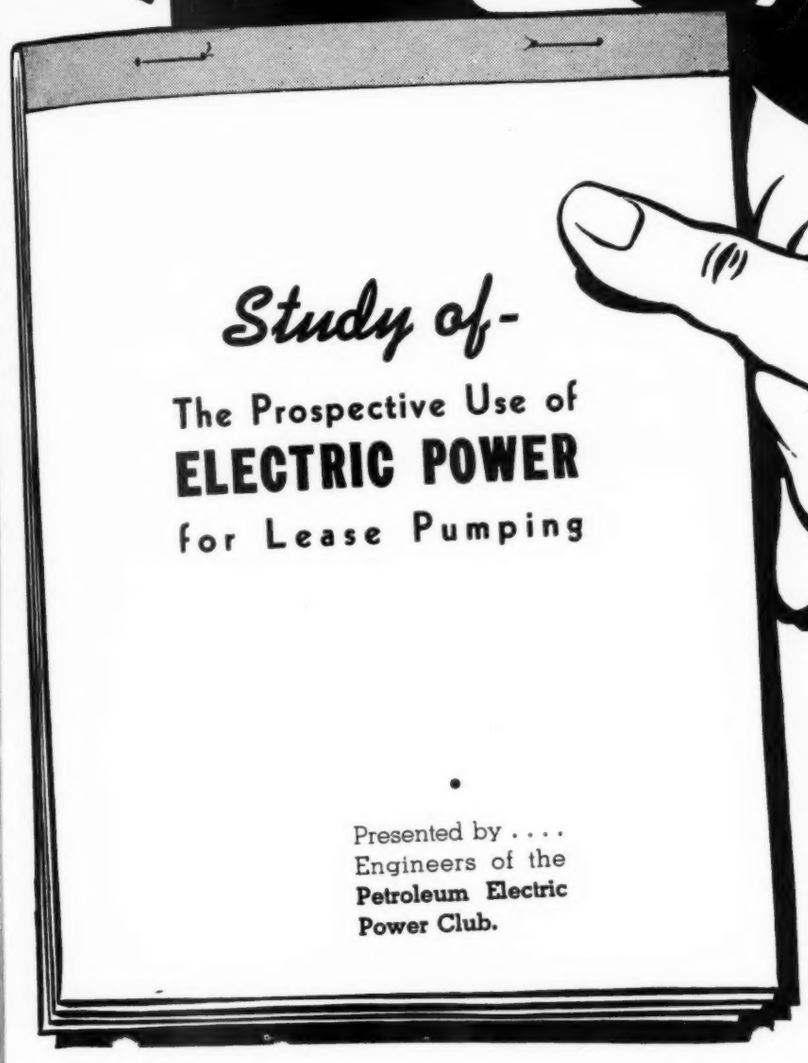

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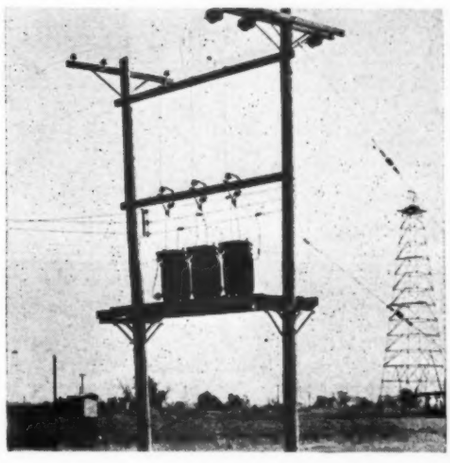

CONSIDER THESE ADVANTAGES OF ELECTRICALLY POWERED UNITS

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- Lower operating, maintenance and labor cost.
- Lower fixed charges (taxes, interest, insurance, depreciation, etc.)
- Greater efficiency.
- Dependable performance at all times.
- Higher salvage value ... easily moved.
- Quiet, clean and modern.
- Less trouble, fewer repairs, smoother operation.

PROFIT BY USING Purchased ELECTRIC POWER

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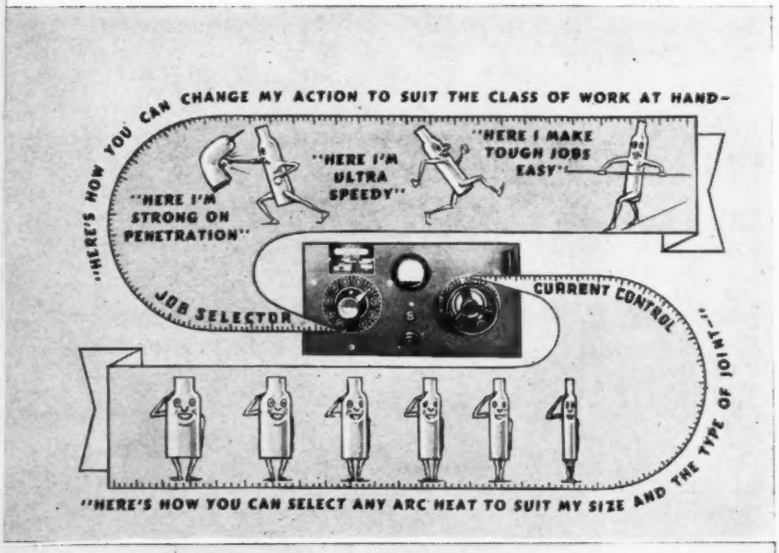
"USE ME WITH THE NEW 'SHIELD-ARC SAE' AND YOU'LL LOWER WELDING COSTS THESE 3 WAYS"


"HERE'S HOW YOU CAN CHANGE MY ACTION TO SUIT THE CLASS OF WORK AT HAND—
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"HERE I'M ULTRA SPEEDY"
"HERE I MAKE TOUGH JOBS EASY"
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"ONE—You get better welds 15% to 20% faster because its Job Selector gives you the right TYPE of welding arc to suit the job.

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"THREE—You can use me in my larger sizes—weld faster and continuously because the 'SAE' is self-protected against burnout.

"If you want yardage gains in welding, just play ball with Lincoln. Yours for lower welding costs,

"FLEETWELD ROD"
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How can the "SAE" do it faster?
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LINCOLN "SHIELD-ARC SAE"

THE WELDER WITH DUAL *CONTINUOUS* CONTROL

PICTORIAL PETROLEUM

A REGULAR FEATURE OF THE PETROLEUM ENGINEER

NOVEMBER 1937

Aerial view taken at dusk of a Texas Company well drilled from a barge in the Lafitte field, South Louisiana

Frank N. Speller of National Tube Company, Pittsburgh, Pennsylvania, who participated in the Division of Production group sessions.

F. B. Rice of Phillips Petroleum Company, Bartlesville, Oklahoma, chairman of the Division of Refining's Nominating Committee

R. S. McFarland of Seaboard Corporation of Delaware, Dallas, Texas, chairman of the Division of Production's Nominating Committee

The [illegible] Institute and the Midcontinent Petroleum Institute at Chicago, was a conference [illegible] speakers and [illegible] contributed in advance.

George A. [illegible], Jr., of Houston Oil Company, Houston, Texas, one of the principal speakers at the first general session.

J. D. Collett of O'Keefe & Co. Oil Corporation, Fort Worth, Texas, who spoke at the first general session.

K. N. Saation of The Texas Company, Los Angeles, California, who acted as chairman of the Engineers' Sub-committee on Wire Rope and Manila Cordage.

H. H. Power, formerly with Gulf Oil Corporation (Gypsy Division) as production engineer, and now professor of petroleum engineering at the University of Texas, who presided at the group session on Production Practice and Research.

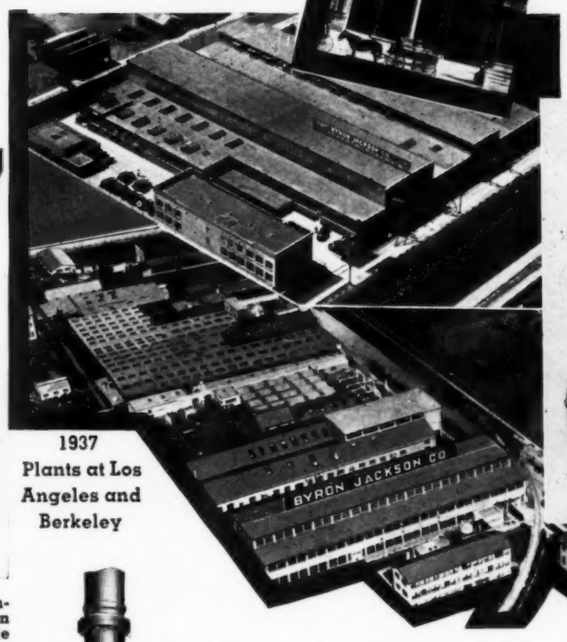
1872 65 Years of ACCEPTANCE Based Upon SERVICE 1937

Artist's conception of 1872 shop.

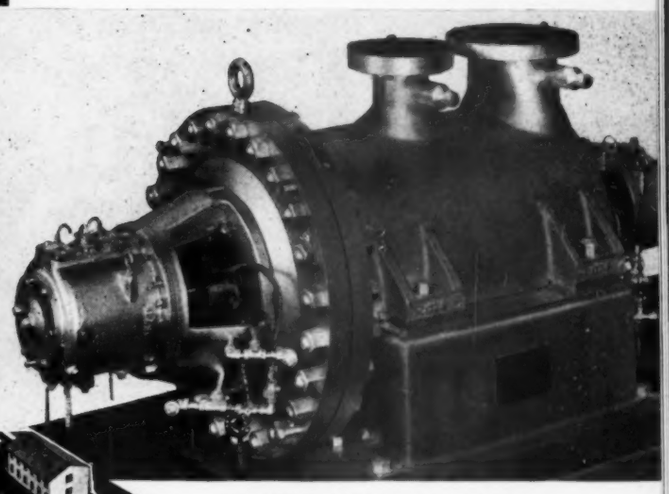
Byron Jackson's Plant of 1880; right above.

San Francisco Uptown Sales Office in the 90's; extreme right.

Mr. Byron Jackson (second from left) inspecting drawings of 1904 Model.



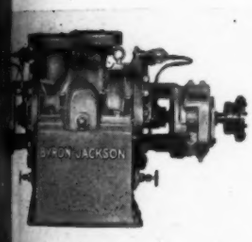
1937 Plants at Los Angeles and Berkeley



DOUBLE CASE HOT OIL CHARGING PUMP

The horizontally split inner case permits assembly of the complete rotating element, *in the shop*, as a separate unit. Details of its modern features available upon request.

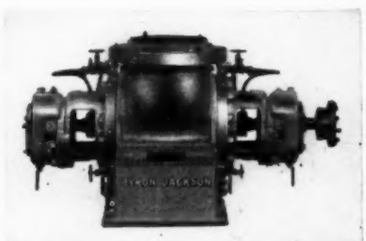
Circular center suspension, concentric with the shaft, permits Byron Jackson Process Pumps to operate at temperatures up to 850 degrees F. without expansion misalignment. The single stage type delivers from 20 to 1,500 G.P.M. against heads to 650 feet; the two-stage Type VC unit (below) is for similar capacities against heads up to 900 feet.



Byron Jackson HYDROPRESS Pumps successfully meet the demand for a pump to handle small capacities at high pressures. The single stuffing box, under suction pressure only—even when pumping against 1500-pound pressure—makes the Hydropress well suited to handle wild oils. Detailed Bulletin is available.

BYRON JACKSON SUBMERSIBLE

Byron Jackson Multiplex Pumps—ideal for cold or warm oil service. Precision workmanship and rugged construction assure users of these pumps long, trouble-free service. Capacities range up to 75,000 barrels per day against pressures up to 1,200 lbs. per square inch.



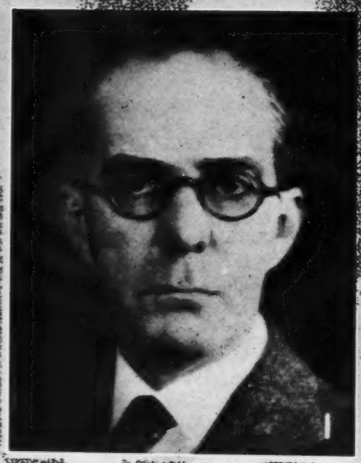
For High Capacity against low or medium heads, the Byron Jackson Single Stage Double Suction Pump has won world-wide acceptance. Support at shaft center line permits free expansion without distortion. Their field of application varies from 800 to 3,000 G.P.M., at temperatures up to 800 degrees F., against heads to 800 feet.

Established 1872

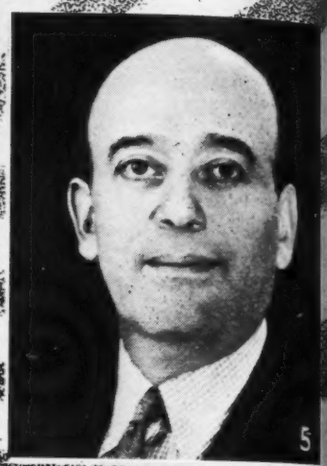
BYRON JACKSON CO.

Factories at: Berkeley and Los Angeles, California
Bethlehem, Pennsylvania

Sales offices: New York, Salt Lake City, Fort Worth



1. Ricardo Silvetra, president.
2. Enrique [illegible] Campos, technical [illegible]
3. Mario [illegible]
4. Roberto [illegible] Yacimientos [illegible]
5. [illegible]
6. [illegible]
7. [illegible]
8. Carlos [illegible]
9. Eduardo [illegible] Bilbao, chief of technical department.

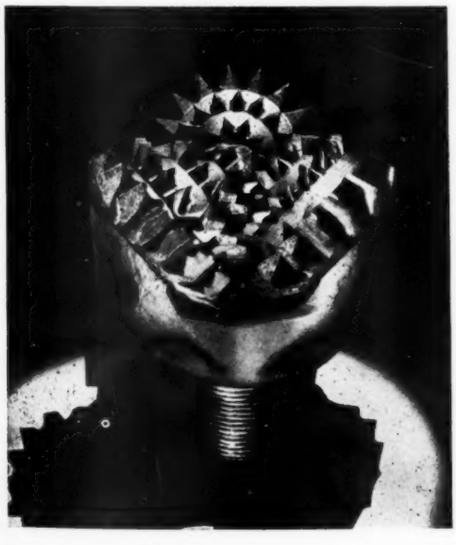


CHIEF OFFICERS AND RANKING ENGINEERS of YACIMIENTOS PETROLIFEROS FISCALES (Argentine Government Oilfields)

IT'S THE *Teeth* THAT COUNT !

Medium Rock Formations may be classed as those having high Drillability, such as twenty to sixty feet per hour with eight to ten points of weight, six lines—90 R. P. M. Many "top" shales, unconsolidated sands, chalk, salt and some lime formations can be drilled at high hourly footage with good circulating equipment. Medium formations have a large penetration weight ratio with good chipping qualities, and are not often gummy. Consequently, cones with good action on bottom and widely spaced, deep self-cleaning teeth, are best for medium formations.

Hughes Type "OSQ-2" Rock Bit



Hughes Series "OS" Tricones, because of these features, are highly recommended by drillers in numerous oil fields. In the medium rock classification, drillability varies according as the hardness or toughness of the formations vary, and in order to take advantage of the best possible combination of tooth design, the Hughes Tool Company has divided their "OS" type of bit into three groups, namely: coarse tooth, medium tooth, and fine tooth. At the lower or softer end of this hardness range, the "OSQ-2" (coarse tooth) Tricone Bit is recommended; while at the upper or harder end, the "OWS" (fine tooth) Tricone Bit is preferable. Intermediate formations require the regular "OSQ" or "OSQ-1" types.

Hughes "Tailor made" Rock Bits are designed for specific formations.

HUGHES TOOL COMPANY

HOUSTON, TEXAS — U. S. A.

L. McKillop, drilling superintendent, Oil Search, Ltd., Sydney, Australia, who attended the Oil World Exposition in Houston.

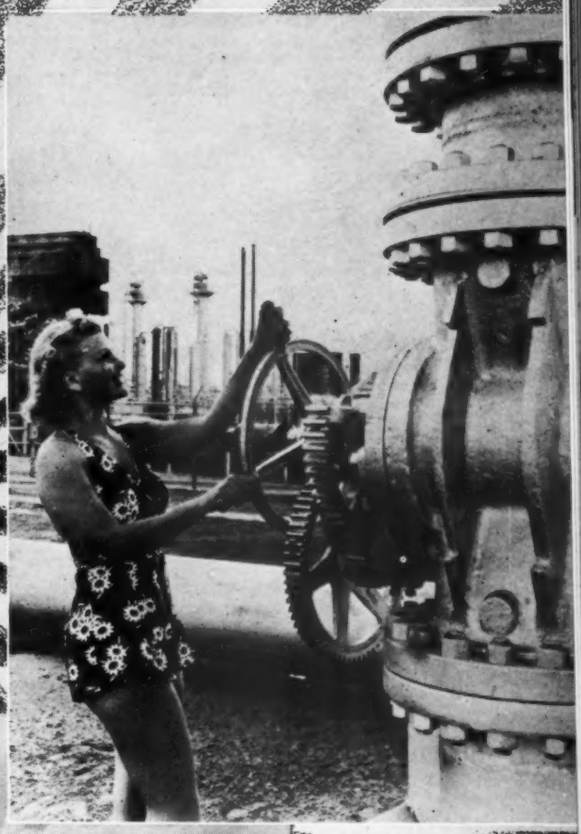
W. O. Scaff, president, Shell Oil Company, California

Acidizing at Gulf Refining Company's [illegible] in the [illegible] gan, fi[illegible] 000 gallons, and [illegible] amount ever used [illegible] Production was [illegible] barrels daily.

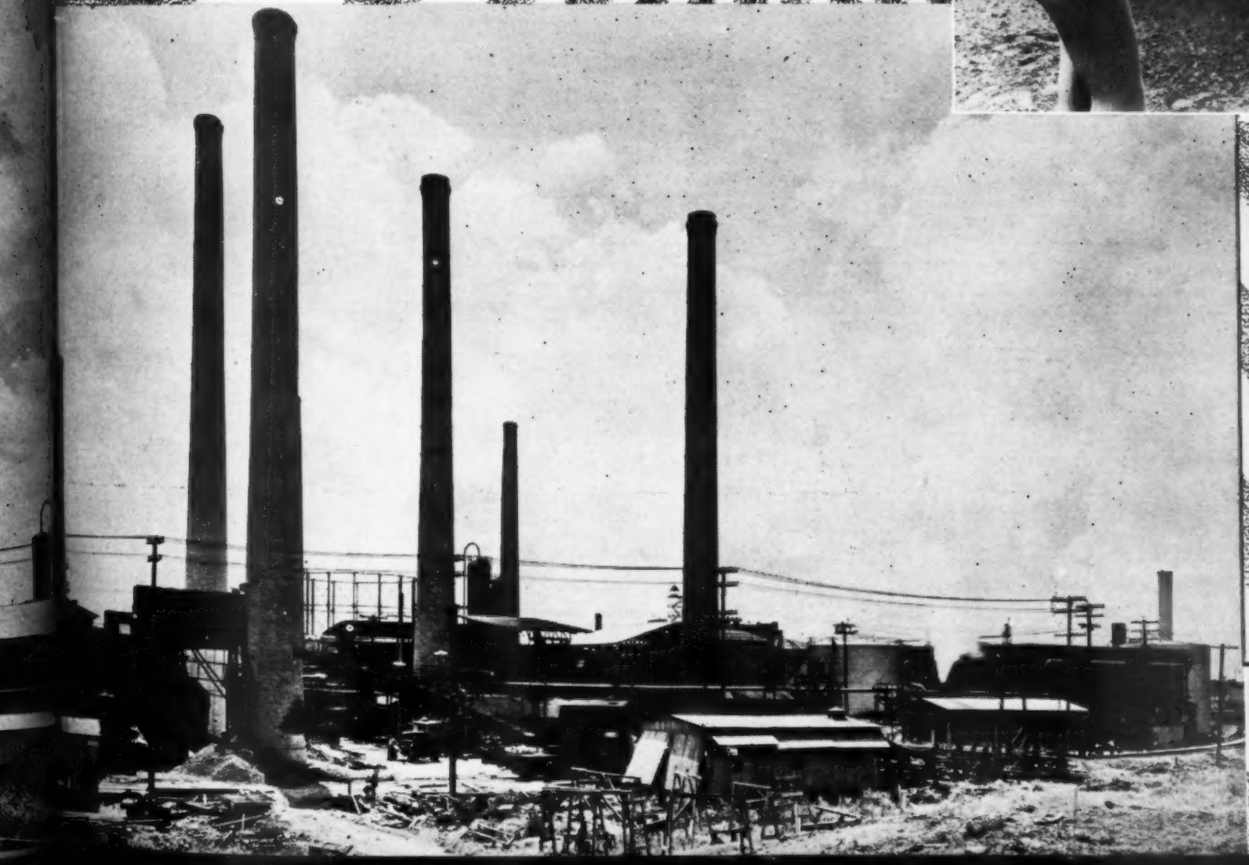
New thermal polymerization plant built by The Atlantic Refining Company at Point Breeze (Philadelphia) refinery to produce gasoline from waste gases generated during the refining process. Largest of its type in the world, the plant is the first to be built in eastern United States. Daily production capacity is 62,500 gallons of gasoline.

The annual sales meeting of The Lincoln Electric Company was recently conducted in the company's new 200,000 sq. ft. factory addition. Shown here are Lincoln sales engineers, dealers and agents from all parts of the country.

L. J. V[illegible] of Petr[illegible] Petroleum D[illegible]ty, Paw[illegible]



Now Nordstrom Lubricated Plug Valves are in the movies. In the current motion picture, "High, Wide and Handsome," based on the oil industry's early struggles, the stars are Irene Dunne, Randolph Scott and Nordstrom Valves. This lady is showing among other things approved valve operating technique.



A Shot in the dark

EVEN A SHARPSHOOTER **has a tough time hitting the target** **if he can't tell where it is.** **That's the reason Lane-Wells developed accurate instruments** **for locating their gun-perforator in the casing. If you order** **a well gun-perforated at 4500 feet, the Lane-Wells crew** **shoots** **at that level. There is no possibility of premature firing** **because the percussion-proof cartridges** **are electrically controlled from the surface** **Lane-Wells safety set-up includes complete liability insurance** **against damage to property and life. If it's results** **you're looking for, call in a Lane-Wells crew**

Other Lane-Wells Products and Services include:

Liner Hangers, Anchor Formation Packers, Rat-Hole Packers, Well Washers, Strata-Graph and Lo-Kate-It Services (outside of California, under license from Oil Well Water Locating Company.)

Tomorrow's Tools Today

Gun Perforator Service

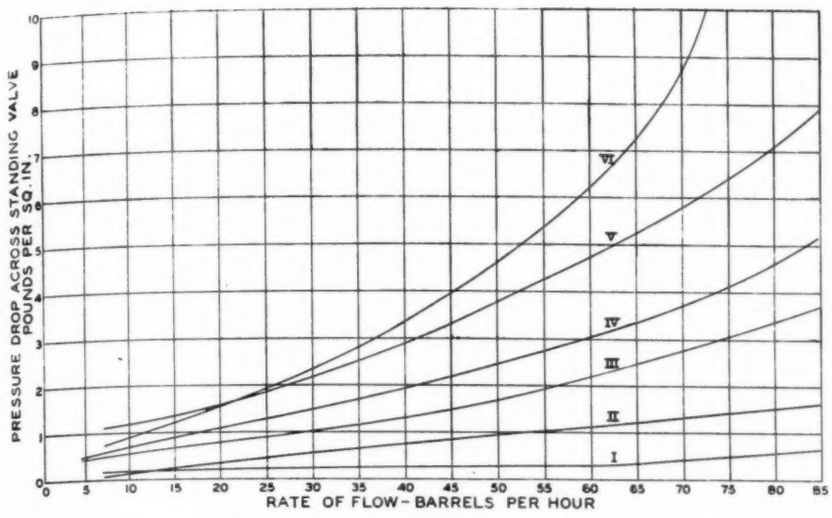


Fig. 1. Standing valve pressure drop data, 2½-in. tubing pump valves

Correlation of physical data with operating conditions facilitates analysis of individual pumping problems

Individual Well Studies Result In More Efficient Pumping

By M. A. WRIGHT[1]

THE actuating of bottom-hole pumps in oil wells by means of sucker rods has been practiced for many years, but it has been comparatively recently that instruments have been developed by means of which accurate measurements of the different factors affecting pumping conditions could be made. Rapid progress has been made during the past year in determining the various factors concerned with well production and equipment, and in taking steps to promote more profitable pumping operation.

Some of this work has been accomplished by the coöperation of equipment manufacturers with operators, but most of it is now being carried on by producing companies that have made pumping well studies a regular part of their petroleum engineering program.

The greater part of the work consists of surface dynamometer studies, although a certain amount of testing is in progress using the subsurface dynagraph, subsurface pressure gauge, and depthograph. Practically every type of instrument in use in the field has been described in recent papers. By using a combination of several of these instruments, a very accurate picture of the pumping conditions of any well can be obtained; however, the expense of running detailed tests with bottom-hole instruments has retarded that phase of the work considerably, causing field engineers to concentrate their efforts on the interpretation of surface dynamometer results.

In the study of factors affecting the pumping of oil, the primary object is to obtain the lowest possible lifting cost per bbl. of oil recovered. To do this the sucker rod pump must be kept operating as efficiently as possible and all associated equipment working under stresses that are not inimical to good operation.

Factors Affecting Pump Efficiencies

Surface dynamometer cards do not give a true picture of bottom-hole pump operation, but an experienced engineer should be able to recognize certain characteristics in them that are indicative of the pump performance.

The most frequently encountered evidence of low-efficiency pumping is known as pounding. It is recognized on the dynamometer card by the fact that the rods do not immediately lose their load as the downstroke begins, but instead, at some intermediate point the load decreases abruptly, falling far below the weight of the rods. This type of pumping is very abusive to the rods, because the stress in a part of the rod string is reversed from tension, for which it is designed, to compression and often results in deformed rods in the lower section. Pounding has been explained as resulting from the fluid head in the well being exhausted and the pump handling all the fluid supplied by the formation, never allowing the head to build high enough to submerge the pump barrel completely. This possibly might be true in some wells, but it is not necessarily so. Pounding is caused by the barrel failing to fill completely with fluid, resulting in the traveling valve not opening on the downstroke until the barrel content is compressed to the same pressure as the top side of the valve, but it may be due to reasons other than lack of fluid. In a well producing considerable gas with a high producing submergence pressure, the compression of this gas in the top of the barrel causes no great amount of impact to be reflected at the surface, but in a low fluid level well having little gas, reflection of pounding at the surface is pronounced. This failure of the barrel to fill with fluid is probably due in many instances to characteristics of high pressure drop at the pump entrance. To illustrate this point, assume that a formation is capable of delivering 100 bbl. of fluid daily to a well bore with a pressure of five lb. per sq. in. at the pump entrance. If the entrance to the pump operating at that displacement is constricted, so as to give a pressure drop of seven lb. per sq. in. at the above rate, it is evident that the submergence pressure would be nullified and the barrel would fail to fill completely; therefore, the well would show pounding characteristics without the fluid being exhausted.

In an effort to evaluate the impor-

[1]Petroleum Engineer, The Carter Oil Company, Seminole, Oklahoma.

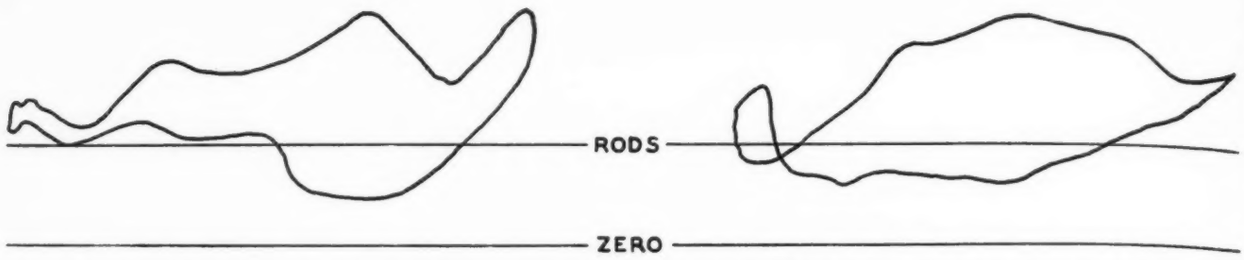


Fig. 2. Seminole Pool well. Pump—1¾-in. bore; 1725 ft., ⅞-in. rods; 2400 ft., ¾-in. rods. Left—Pump using regular standing valve—length of stroke, 54 in.; s.p.m., 21½; maximum load, 15,200 lb.; minimum load, 3230 lb., rod hp., 13.4. Right—Pump using oversized tubing type standing valve—length of stroke, 54 in.; s.p.m., 22; maximum load, 14,600 lb.; minimum load, 3550 lb.; rod hp., 13.0.

tance of standing valve design, a series of flow tests have been recently completed on a group of competitive 2½-in. tubing type pump standing valves. Fig. 1 shows the results of these tests. Valves III and IV are the removable type that can be pulled through the tubing, and the others are over-sized valves of different design that screw into the bottom pump collar. It will be noted that the flow characteristics cover a rather wide range, considering that they are all recommended for the same service.

In making use of this information, a test was run recently on a well in the Seminole area. The well had approximately 15 ft. of fluid in the hole, and was pumping at 21 54-in. strokes per minute with a 1¾-in. bore insert pump having a conventional 15/16-in. bore standing valve and producing 105 bbl. of oil and 145 bbl. of water daily. The well pounded violently at mid-downstroke. The tubing was pulled and a tubing pump valve shown on the curve as No. II was attached. The standing valve was then removed from the pump and the hold-down bored out to 1½ inch. The pump was then rerun and the well pumped. A considerably better dynamometer card was obtained and the well produced 137 bbl. of oil and 178 bbl. of water daily. Fig. 2 shows the cards taken before and after the change.

In many wells, the pound can be lessened or totally eliminated by changing the speed or length of stroke. Fig. 3 shows the card taken on a well in the Oklahoma City field pumping at 16 62-in. s.p.m. and a later one taken after slowing the speed down to 14 62-in. strokes per minute. In making this change, no decrease in production was suffered, while the dynamometer card was materially improved.

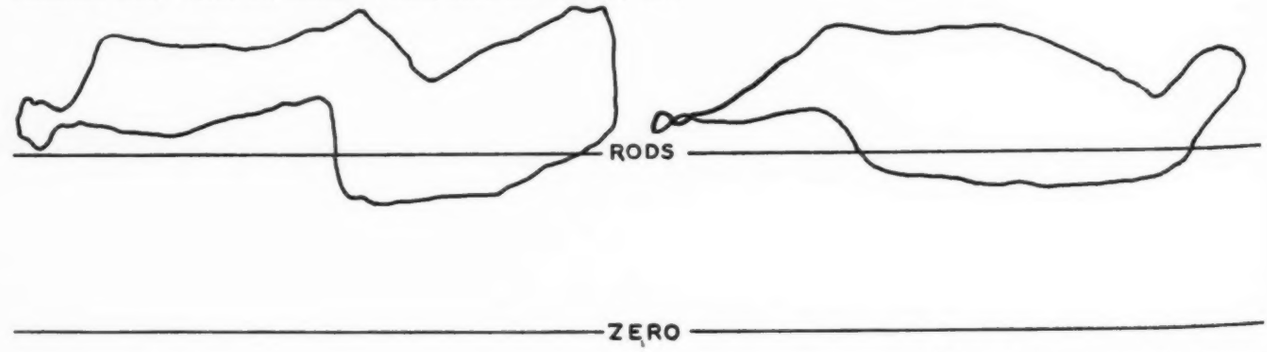
A rather unusual pump condition was investigated recently in a well in the Seminole Pool. This well normally was pumped at 25 54-in. s.p.m., with a 2¼-in. bore 10-ft. tubing liner pump having a 48-in., .004-in. clearance plunger and produced approximately 625 bbl. of fluid daily. The production of the well began declining abruptly, so a dynamometer card was taken. The card indicated that the rods were not falling freely, so the opinion was expressed that the plunger was sticking. When the pump was pulled, it was found that one liner in the pump was cracked and that the plunger was badly worn. The cracked liner probably allowed the fluid column pressure to build up and discharge between the jacket and the liners each stroke, thereby causing the liners to "breathe." The liners and plunger were replaced and rerun. The well production regained its former volume and the pumping motion again was smooth. Fig. 4 shows the dynamometer cards taken before and after the pump change.

Overstressed Sucker Rods

In the history of pumping, as wells have been pumped from progressively greater depths, the same type rod strings and pumps as previously used in shallower fields have been installed. When 4000-ft. pumping was initiated ¾-in. rod strings were installed as they had been in 2500-ft. wells. Then, as wells 6000 ft. deep were put on the beam, ⅞-in. and ¾-in. tapered rod strings were installed because they had proved most satisfactory in 4000-ft. pumping. As a result there has been and still is a big field open in the investigation of means of relieving sucker rod stresses that pays large dividends in decreased downtime and maintenance costs.

Fig. 5 shows graphically the results that have been obtained by one major producing company in the Seminole area as a result of approximately one year of concentrated effort toward relieving sucker rod stresses. The course followed in these studies has been to investigate with a surface dynamometer all wells that indicate the approach of excessive rod failure. From the dynamometer cards, it has been possible to determine the reason for the diffi-

Fig. 3. Oklahoma City well. Pump—1¾-in. bore; 3075 ft., ⅞-in. rods; 3400 ft., ¾-in. rods. Left—length of stroke, 62 in.; s.p.m., 16; maximum load, 20,100 lb.; minimum load, 7700 lb.; rod hp., 15.6. Right—length of stroke, 62 in.; s.p.m., 14; maximum load, 19,000 lb.; minimum load, 8600 lb.; rod hp., 12.9.



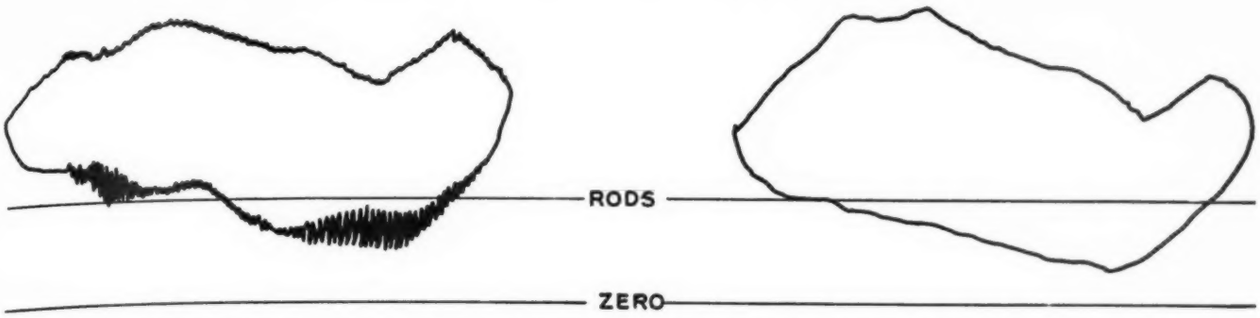


Fig. 4. Seminole Pool well. Pump—2¼-in. bore; 1525 ft., ⅞-in. rods; 2650 ft., ¾-in. rods. Left—card showing plunger sticking. Right—card after repairing pump.

culty. In practically every well the cause of excessive rod trouble has been overstressed rods and the trouble has been corrected either by decreasing the pump plunger diameter, installing a properly designed rod string, or operating the well at a more favorable motion.

In the Oklahoma City field, the first rod strings installed were composed of approximately 40 percent ⅞-in. rods and the remainder ¾-in. rods, which actuated pumps with plunger diameters as large as 2¼ inch. It was only a short time, however, before it was found that smaller plungers were preferable for this depth. The maximum size plunger used in general is 1¾ in. at the present time. It has been found that, even with these smaller plungers, the rods are overstressed in a great many instances; also contributory to low rod service in many wells has been the fact that the pump was pounding. Wells in which this type of loading occurs almost invariably show a high rod-failure frequencey in the top of the lighter section of a tapered string of rods. Many operators therefore have "chased" the breaks with heavier rods from the mid-section of the string to the bottom, ending with a full string of the ⅞-in. rods. In general, it may be said that in Oklahoma City full strings of ⅞-in. rods give better service in pounding wells than ⅞-in. and ¾-in. tapered strings, and that in extremely heavy wells tapered strings of 1-in. and ⅞-in. are necessary to bring down the unit stress to a point where good rod service is obtained. Three-size tapered strings, 1 in., ⅞ in., and ¾ in., have not proved satisfactory due to the small rods being subjected to high compressive loads upon the failure of the heavier rods at the shallow depths.

As an example of the service by rod strings in the Oklahoma City Pool, Table 1 is given.

Some operators in Oklahoma City have been doing considerable experi-

TABLE 1

Installation		Date Installed	Total Rod Failures ¾ in.	⅞ in.	1 in.	Days Service
Well "A"	2425 ft.—⅞ in. 3900 ft.—¾ in.	1-13-36	9			156
	6325 ft.—⅞ in.	12-28-36		2		210
Well "B"	2475 ft.—⅞ in. 3900 ft.—¾ in.	4-23-36	7	3		170
	6375 ft.—⅞ in.	10-16-36		7		283
Well "C"	6400 ft.—⅞ in.	11- 4-36		15		129
	1000 ft.— 1 in. 5400 ft.—⅞ in.	3-18-37		4	3	129

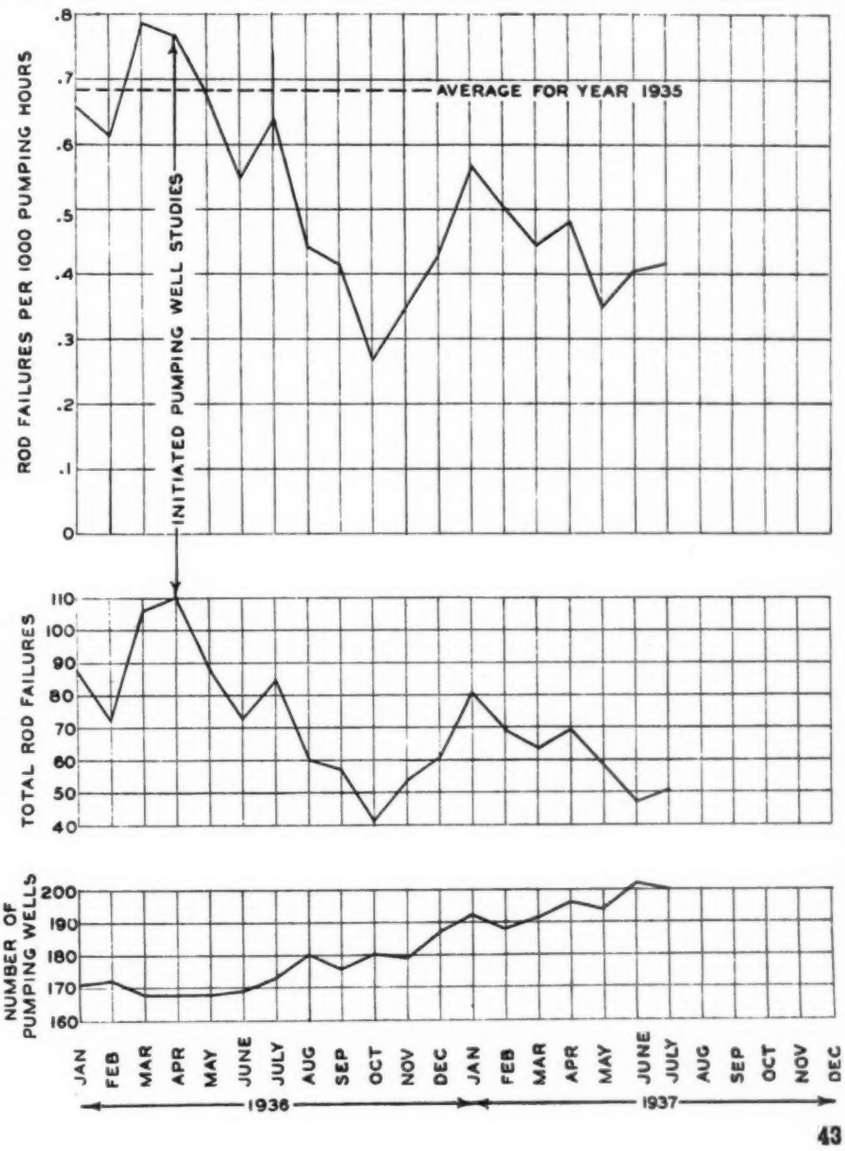


Fig. 5. Rod failure frequency data, Seminole area

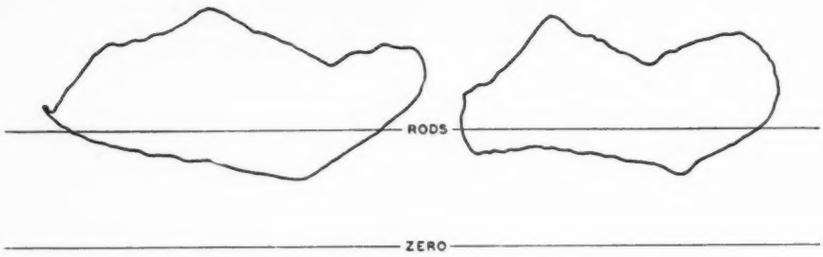


Fig. 6. Oklahoma City well. Pump—1¾-in. bore; 3800 ft., ⅞-in. rods; 2600 ft., ¾-in. rods. Left—length of stroke, 62 in.; s.p.m., 17; maximum load, 24,500 lb.; minimum load, 7100 lb.; rod hp., 27.6. Right—length of stroke, 52 in.; s.p.m., 20; maximum load, 23,300 lb.; minimum load, 7400 lb., rod hp., 27.0

menting with different lengths and speeds of stroke in wells of high fluid capacity for the purpose of obtaining large pump displacement with a minimum rod stress. In some wells it has been found that short fast strokes give lower stresses than the slower long strokes that give the same pump displacement; however, the increased number of reversals of the short stroke may result in actually shorter rod service, as the endurance limit of highly-stressed steel is a function of the number of reversals. Fig. 6 shows typical dynamometer cards taken on an Oklahoma City well at different lengths of stroke that result in approximately the same plunger displacement.

It will be noted that, although the stress is 2000 lb. per sq. in. lower at the shorter stroke, the number of reversals is increased 18 percent. Whether this will result in longer rod service or not is a point yet to be proved conclusively.

High rod stresses are caused by other than normal fluid loads and the impulse resulting from the harmonic motion of pumping. As an example, in the North Searight Pool a well was pumping normally with a smooth rod load recorded by the dynamometer. As an experiment a tubing anchor was run into this well and set 800 ft. off bottom. It was thought that in this manner a longer effective plunger stroke would be attained. For a short time after setting the anchor the well produced normally, then suddenly the rods began giving trouble. A dynamometer test was made and a very uneven card recorded, as shown in Fig. 7. Recommendation was made by the field engineer that the anchor be released and when this was done, the rod loads returned to their former figure and no more excessive trouble occurred. The conclusion drawn was that the anchor had started creeping up the hole, corkscrewing the tubing, and causing unnecessarily high friction loads.

Unstable rig fronts are a frequent cause of high shock loads being transmitted to the rod string. Fig. 8 shows graphically the shock and vibration resulting from worn gears in a gear-reduction pumping unit. Worn rig-front bearings and loose members are usually reffected on dynamometer cards, but they are not always as pronounced as in this instance.

Conclusion

The coöperation that exists between manufacturer and operator in making these studies tends to promote a better understanding of the use and limits of equipment, and already longer and more efficient service is being realized from pumping equipment. The future should see even greater benefits in this direction.

It is believed that soon all major producing companies will obtain a progressive history of each pumping well's behavior by making and keeping on file routine dynamometer tests. In this way any change in pumping conditions will be detected and can be analized intelligently. The benefits that can be derived from individual well studies are being realized more and more by the producing companies.

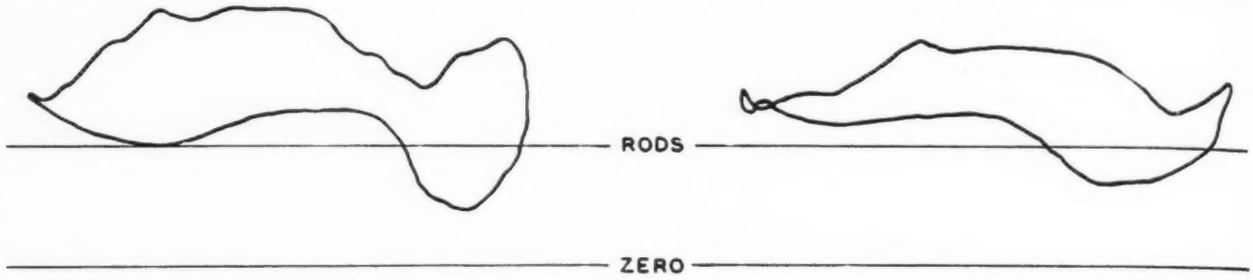


Fig. 7. North Searight Pool well. Pump—2¼-in. bore; 2000 ft., ⅞-in. rods; 2550 ft., ¾-in. rods; tubing anchor at 3800 feet. Left—tubing anchor set. Length of stroke, 54 in.; s.p.m., 18; maximum load, 16,700 lb.; minimum load, 3850 lb.; rod hp., 14.75. Right—tubing anchor released. Length of stroke, 54 in.; s.p.m., 18; maximum load, 14,600 lb.; minimum load, 5300 lb.; rod hp., 9.4

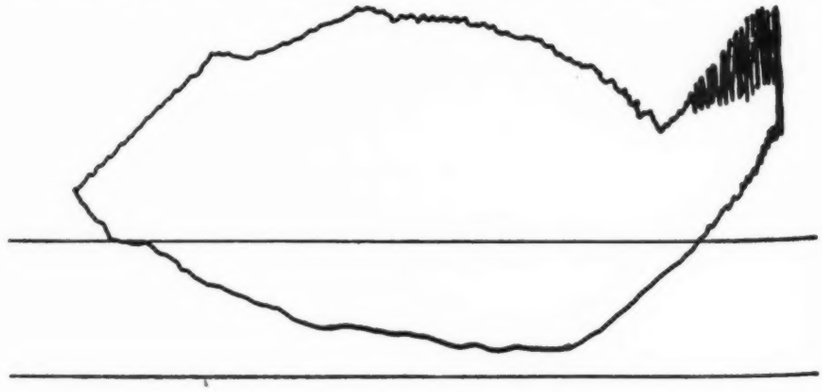


Fig. 8. Card showing effect of worn reduction gear on rods in a Seminole pool well. Pump—2¼-in. bore; 1525 ft., ⅞-in. rods, 2575 ft., ¾-in. rods. Length of stroke, 64 in.; s.p.m., 24; maximum load, 20,200 lb.; minimum load, 1350 lb.; rod hp., 43.1

The Howard Process*

Treating of gasoline, straight-run or cracked, by this process is said to give a product of excellent odor, good color, and one that is sweet and non-corrosive, gum free, high in octane, and of high lead susceptibility

By EMBY KAYE[a]

THERE has been considerable speculation concerning the Howard Process since the subject was announced as to (1) what the Howard process is, (2) what it does, and (3) how it does it.

Let it be understood at the outset that this paper has been prepared on the writer's own responsibility. The owners of the process declined to present a paper on the subject at this time, for reasons that will become evident later on herein. The writer intends to discuss these enumerated items largely on the basis of development work that has been done in a semi-commercial plant. Several commercial installations are now in progress and it is hoped that in these plants the lessons taught by the pilot units will be translated into commercial operation. Indeed, a good deal of this already has been accomplished.

During the past several years, a number of treating processes have been developed and commercially introduced in refineries from coast to coast. These processes have sought among other things to improve gasoline by chemical treatment. One process polymerizes gum, another sweetens gasoline by a method new to the industry, and still another process sweetens gasoline by a method that represents a variation of the conventional doctor-treating. Closely related to gum polymerization is the increasing use of inhibitors that retard the formation of gum. Inhibitors have also been developed for use as color stabilizers. One of the processes referred to, in addition to the polymerizing of gums and eliminating them from the gasoline stream, stabilizes the products for color. Still another process has been developed and used by several large companies, in which the gasoline is washed with strong caustic solutions and doctor-treating as such eliminated.

In some of these processes, the objective of course is the elimination of acid-treating and rerunning, while in others it is the elimination of conventional doctor-treating. The objectives are the elimination of the losses inherent in their use as well as the degradation of the product either as to octane number or lead susceptibility, in addition to other economies.

The process that shall be discussed here accomplishes these results in one operation, and the writer should say that as far as observations have been made it does the job better in some respects. Gasoline—straight-run or cracked—treated by the process is of excellent odor, of good color, is sweet and non-corrosive, gum free, of as good as or better octane than the untreated gasoline, and as good or better in lead susceptibility. In addition, the sulphur content of the gasoline is reduced.

This process has been under study for a great many years. The Petroleum Research Corporation, under its chief chemist, Roscoe D. Howard, has brought many years of effort to what may be considered successful fruition. In its essence, it is a vapor-phase treating process, not unlike in its physical operation other processes with which the refiner is familiar.

The flow through the treating unit is illustrated in the accompanying chart. Stabilized gasoline, with propane, hydrogen sulphide, and excess butane eliminated by fractionation, and to which chlorine has been added, is vaporized in a fractionating column and the vapors passed into a contact tower below a bed of oxidized zinc, such as zinc oxide or zinc oxychloride, which is dispersed through the tower in a solid binder of one of various possible kinds. The vapors issuing from the tower are then fractionated and the overhead condensed as finished gasoline. Polymers from the final fractionator and from the bottom of the contact tower are fed into the stripper tower with the raw gasoline and ultimately the bottoms from this tower, containing all the stripped polymers, are diverted to fuel oil or to other operations, according to the usual practice in the particular plant.

Discussion of unit capacities, volume of zinc oxide per daily bbl. of charging stock, rate of flow, and other data are designedly not included herein, possibly because of lack of general interest in details at this time.

While several specific inspections of products, before and after treatment, will be shown, some general comments might be made regarding the type of improvement that may be anticipated by subjecting gasoline to this process.

In the matter of color, gasolines may be treated to 30 plus. Upon exposure to three weeks of sunlight, samples of cracked gasoline have retained a color in excess of 21 without the deposition of any gum or the development of haze, which usually accompany extended exposure to sunlight.

Odor, as well as color, adds no particular value to gasoline as such, but from a commercial standpoint both color and odor are frequently capitalized. The effectiveness of the process to eliminate certain sulphur compounds from the gasoline results in the production of an exceptionally sweet gasoline, if good odor may be defined as sweet. The odor is more than neutral—it is actually sweet.

Samples of gasoline stored as long as a year continue to show negative doctor test. In the matter of gum removal, gasolines after treatment show contents of from 2 to 12 mgs. by the copper dish, but show no gum by the glass dish. Different stocks of course account for the difference in gum content. It also has been found that the induction period varies considerably, according to the type of material treated. Vapor-phase gasolines that have been treated show from six to ten hours' induction period but the average Mid-Continent cracked gasolines from the conventional types of cracking processes revealed induction periods of 15 to as great as 30 hours.

As has been indicated, the sulphur reduction is material, averaging on the order of 50 percent. The reduction in

*The substance of a paper delivered before Regional Technical meeting of the Western Petroleum Refiners Association, Shreveport, Louisiana, October 22, 1937.

(a) Skelly Oil Company.

sulphur, however, has been as little as 15 percent on some products, while in other instances as much as 80 percent of the sulphur has been removed. Although the nature of the chemical reactions involved, which doubtless account for the differences in results, is little known, it has been definitely ascertained that the reduction in total sulphur is equal to the mercaptan sulphur content of the charge, although it is usually more than that. One might hazard the opinion that the sweetening operation involves the elimination of mercaptans rather than conversion to the sulphide sulphur, or, if the conversion does take place, sulphide sulphur is removed from the system. The definite tracing of the chemical reactions is of interest to the chemists and to the process company. The writer's particular present interest is solely in the results and in the operability of the process. It is not necessary to complete this technology now because it is not necessary to utilize the process on the basis of predicted results. The present approach of course must be on the basis of the treatment of quantities of material through pilot plants, where actual results may be obtained and studied, on the basis of which the individual processor can determine the economics involved.

Tied in with the sulphur reduction, and obviously closely related to it, is the affect upon the octane number and lead susceptibility of gasoline treated by this process. It has been indicated from numerous tests that the octane rating of the treated gasoline is at least as high after treatment as before. It suffers none of the diminution in octane number experienced in the conventional plumbite or acid-treating processes. Samples treated by pilot plants show several octane numbers higher than refinery samples treated by the former methods. The refiner, however, is not so much interested in octane number as he is in lead susceptibility, because in any event most of the gasolines manufactured by present processes still need lead to bring them up to commercial standards. The lead susceptibility of the treated gasoline therefore is of the utmost importance. It has been indicated by numerous tests that the increase in lead susceptibility varies with the sulphur reduction, although it is equally well demonstrated that gasolines of very low mercaptan content showed little or no increase in lead susceptibility. For naphthas requiring approximately three cc. of lead to 70 octane before treatment, the lead required was reduced by one cc. It does not require a great deal of arithmetic to show the possible economies involved in the successful treatment of straight-run gasoline having an octane number between 45 and 50. The savings seem almost incredible.

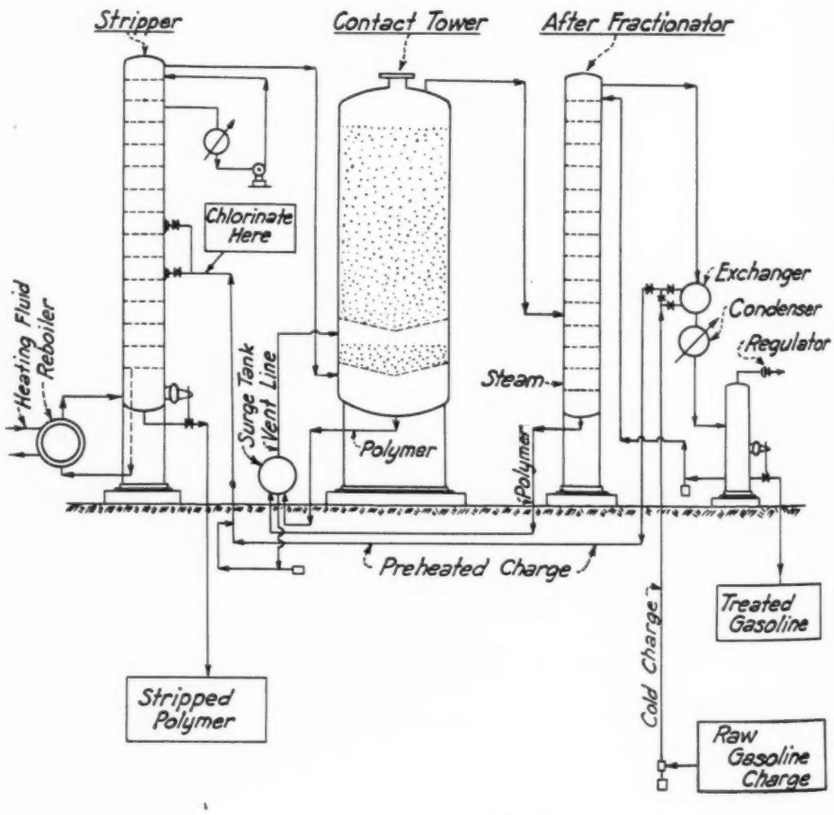
The pilot plant operation points to a long life for the oxidized zinc. Runs have been made that extended well beyond the probable theoretical life of the chemical if the reactions had been entirely chemical. It has been found in practice that the chemical may be regenerated by turning steam into the bed. The activity of the chemical bed thereupon is as effective as far as is known as it was in its original condition. Although in plant practice there has been some erosion of the bed, changes in flow have been made that will, or in any event should, eliminate this condition. A commercial plant that is beginning operations probably this very hour will thoroughly demonstrate the effectiveness of the improvements in design that have been made since the first semi-commercial unit was installed at a refinery.

On the basis of the life of the chemicals actually experienced in the pilot plant, many products would justify the use of the process on the basis of cost. Just how cheap the process ultimately will be will depend upon the life of the bed for various stocks when that life is ultimately determined. Necessarily, it will require a considerable period of operation to discover the ultimate life in view of the present favorable experiences with the maintenance of full activity of the chemical bed. The life of the chemical bed will determine the ultimate cost of the process for the several services its gives.

This recital of what the process has done in the pilot plant and what it has done to an extent in a commercial installation suggests many uses for the treatment of special products not discussed herein, where particular inspections on the finished product are desired.

Although the owners of the Howard Process have been conservative in their exploitation of the inherent possibilities of the process, the writer has urged upon them the desirability of putting it before this forum. The writer feels that with the information made available to the technologists in the industry, considerable supplementary work can be done by interested investigators, or applications made by refiners, many of whom would be able to make contributions to the more certain translation of the process into complete and full utilization in the commercial field. The savings inherent in the process are too valuable to hold back its commercial development.

Flow diagram of the Howard Vapor-Phase Process for treating light petroleum distillates



Here is an inspection of pressure distillate and straight-run gasoline produced from Kansas crude, before and after treatment by the Howard Process.

REFORMED GASOLINE PRESSURE DISTILLATE

	Raw Pressure Distillate	Gasoline Howard Process Treated and Fractionated
A.P.I. Gravity	51.1	51.7
A.S.T.M. Distillation		
I.B.P.	112	104
Percent		
5	164	156
10	202	190
20	249	240
30	286	272
40	314	292
50	332	312
60	354	338
70	374	354
80	390	372
90	415	392
95	454	406
End Point	458	418
Recovery, percent	96.0	97.8
Doctor Test	....	Sweet
Corrosion Test	....	O. K.
Color	....	30+
Octane Number	59.0	59.0
Lead to 70 Octane		
A.S.T.M., cc.	1.80	1.80
Sulphur, percent	0.0214	0.011

LIGHT STRAIGHT-RUN GASOLINE

	Original	Howard Process Treated
A.P.I.Gravity	64.8	64.1
A.S.T.M.Distillation		
I.B.P.	98	108
Percent		
5	134	144
10	152	161
20	180	183
30	200	202
40	....	217
50	234	233
60	250	247
70	266	263
80	286	286
90	316	311
95	332	330
End Point	352	360
Recovery, percent	98.0	98.8
Doctor Test	....	Negative
Corrosion Test	poor	O. K. 6 hr. at 212 deg. fahr.
Color	30+	30+
Octane Number	50.0	50.2
Lead to 70 Octane		
A.S.T.M. cc.	2.7	1.7

Laboratory Test Results Upon Several Types of Cracked and Straight-Run Products

1. Cracked P. D. from Michigan Crude

Sample	Raw	Finished
Gravity	61.6	61.3
Doctor	Sour	Sweet
Color	Lt. Yellow	30+
I.B.P.	80 deg. fahr.	88 deg. fahr.
10 percent	124	130
90 percent	350	355
E. P.	381	404
Gums—Cu. dish	85.0 mgs.	3.3 mgs.
Induction	115 Min.	400 Min. plus
Total Sulphur	0.0467	0.024
Mercaptan Sulphur	0.0250	0.0000
Cu. strip	N. G.	O. K.

2. Straight run gasoline from Texas Panhandle Crude

Sample	Raw	Finished
Gravity	61.6	60.9
Doctor	Sour	Sweet
I.B.P.	101 deg. fahr.	105 deg. fahr.
10 percent	158	159
90 percent	364	358
E. P.	398	402
H_2S Sulphur	0.0221	0.0000
Total Sulphur	0.0644	0.0194
Mercaptan Sulphur	0.0392	0.0000
Cu. strip	Very corrosive	O. K.
Reported Octane	49	56.2

Duplicate results obtained when using contact material that had treated an amount equal to 1000 bbl./ton.

3. Highly Unsaturated Cracked Naphtha—California

Sample	Raw	Finished
A.P.I. Gravity	49.2	49.4
Doctor	Sweet	Sweet
Color	Lt. Yellow	30
I.B.P.	112 deg. fahr.	116 deg. fahr.
10 percent	158	158
90 percent	302	300
E. P.	364	407
Gums—Cu. dish (old style)	370.1 mgs.	1.4 mgs.
Induction	0 Min.	85 Min.
H_2SO_4 absorption 1.84 Sp. gr.	48 percent	34 percent
Total Sulphur	0.0199	0.0192
Cu. strip	O. K.	O.K.

4. Cracked P. D. from Naphthenic Base Crude—Gulf Coast Area

Sample	Raw	Finished
Gravity	55.0	54.6
Doctor	Sour	Sweet
Color	Orange	30+
I.B.P.	76 deg. fahr.	82 deg. fahr.
10 percent	137	138
90 percent	361	354
E. P.	375	388
Gums—Cu. dish	191 mgs.	14 mgs.
Induction	145 Min.	400+
H_2S Sulphur	0.0018	0.000
Total Sulphur	0.063	0.042
Mercaptan Sulphur	0.017	0.000
Cu. strip	N. G.	O. K.

Petroleum Industry to Benefit From WPA Project

DATA on more than 15,000 genera and species of foraminifera, including 45,000 illustrations, are to be available for the information of geologists, engineers, and other scientists as a result of work now being done by the Geological Research Project of the Works Progress Administration in New York City. Substantial progress toward the completion of the gigantic task of assembling this material has been reported to the Washington, D. C., office of the Division of Women's and Professional Projects of the Works Progress Administration. Ellen S. Woodward, assistant WPA administrator, is director of this division.

Results of the project are expected to be of material benefit to geologists, to the mining and petroleum industries, and to those engaged in city planning, in agriculture and in the control and development of water ways.

Workers on the project are collecting material on foraminifera never before assembled in one place. Shells of these microscopic, single-celled animals are found in the rock layers making up the outer crust of the earth. Through identification of the tiny fossilized remains, an estimate can be made of the type of rock or soil to be encountered in drilling or excavating operations. They serve the geologist or the engineer as the X-ray serves the surgeon.

In both the pure science of geology and its various applied forms, one of the most important considerations is the age of the different rock layers and their arrangement in relation to each other. Of the several ways in which ages and relationships can be determined by far the most accurate method is by means of animal remains embedded in the rocks. These animals lived in the ancient seas during the geologic age in which the particular rock layers were formed. Certain species of fossils occur in rock layers of a particular age regardless of the geographic location of the rock formations. By identifying the animal remains of a rock layer, its age and its relationship to adjacent layers may be determined.

The foraminifera are especially valuable in making such determinations. They are widely distributed; they have lived in great numbers since early geologic times; and many species are sharply restricted to rock formations of a certain definite period.

Although geologists have been accumulating data on foraminifera for more than 200 years, this material has never been presented in a systematized form. A vast amount of unorganized data exists in geological libraries throughout the world; but only in large cities, such as New York, London or Rome, is there anything approaching a comprehensive collection of material. Even these collections are of little use to the research worker, as they are in chaotic condition.

It is the task of the Geological Research Project to collect and orientate material on foraminifera so that for the first time it may be presented to the scientific world in usable form for ready reference. The finished product will consist of at least 25 volumes of about 1000 pages each, containing in all approximately 45,000 illustrations and bound in loose-leaf form so that supplementary material may be added to keep the work up to date.

The vision that made the project possible must be credited to Dr. Brooks F. Ellis, geologist of note, who more than ten years ago started unaided the long and difficult task. In 1930, he joined the faculty of New York University and subsequently obtained the help of student assistants. Later he was aided by workers from the Emergency Work Bureau and the Civil Works Administration. New York University and the American Museum of Natural History agreed to supply the necessary literature. Finally, with the creation of the Works Progress Administration, the enterprise was made a WPA project.

Electric welders at work on a section of 10-in. line

By

W. B. FULTON*

Methods Employed in Constructing

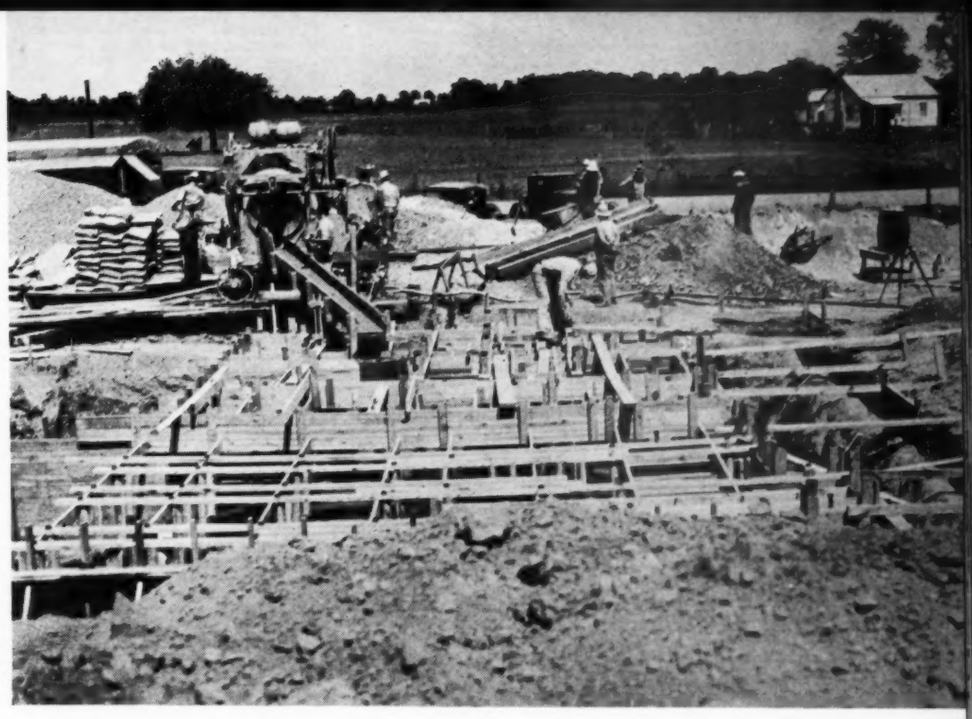
THE pipe line system that has been under construction in South Louisiana for the Standard Oil Company of Louisiana, Pipe Line Department, since September 1st was completed early in November, giving the Roanoke and Jeanerette fields a direct connection with the Standard's refinery at Baton Rouge. The system consists of 46 miles of 6-in. pipe from the Roanoke field to Sunset, a 6-in. line from the Jeanerette field to a junction point at Breaux Bridge, and an 8-in. line from this junction to Sunset. At Sunset the two lines converge into one 8-in., extending to a junction between Lottie and Lavonia. From there to Port Allen, a distance of 22½ miles, the line is of 10-in. pipe. The entire project consists of 150 miles of pipe line, with pump stations at Roanoke, Jeanerette, and Sunset.

Although the route of the line was through country that for the most part permitted the use of ordinary construction practices, certain areas presented difficulties that called for ingenuity on the part of the contractors. The widest bodies of water crossed were the Atchafalaya River, Cortableau Bayou, and Bayou Teche, the latter being crossed four times. The Atchafalaya River was the widest and most difficult to cross. In addition to these some 20 to 30 small bayous and numerous irrigation and drainage canals were crossed. Between Sunset and Lottie, a distance of 25 miles, the right-of-way is through a swamp that is under water approximately nine months of the year. Through this area the stove-pipe method of laying the pipe was employed to facilitate handling under adverse conditions. From Jeanerette to Sunset and from Sunset west to Roanoke the line traverses an intensely cultivated area of sugar cane plantations and rice farms. Approximately 50 miles of the right-of-way is through heavily timbered land, necessitating clearing before the pipe could be strung.

Line pipe was shipped to points convenient to the job and was strung from trucks. The only difficulty encountered was in the swampy areas and here it was necessary to employ tractors to haul in the trucks. Conventional-type ditching machines were used to provide the trench for the pipe,

*Chief, Engineering Division, Standard Oil Company of Louisiana, Pipe Line Department.

A portion of the line was laid by the "stove-pipe" method, shown here



Equipment set up ready to pour mattes at the Sunset Station

Roanoke and Jeanerette fields given direct outlet to refinery at Baton Rouge. Three pump stations erected by Standard Oil Company of Louisiana as a part of its new facilities

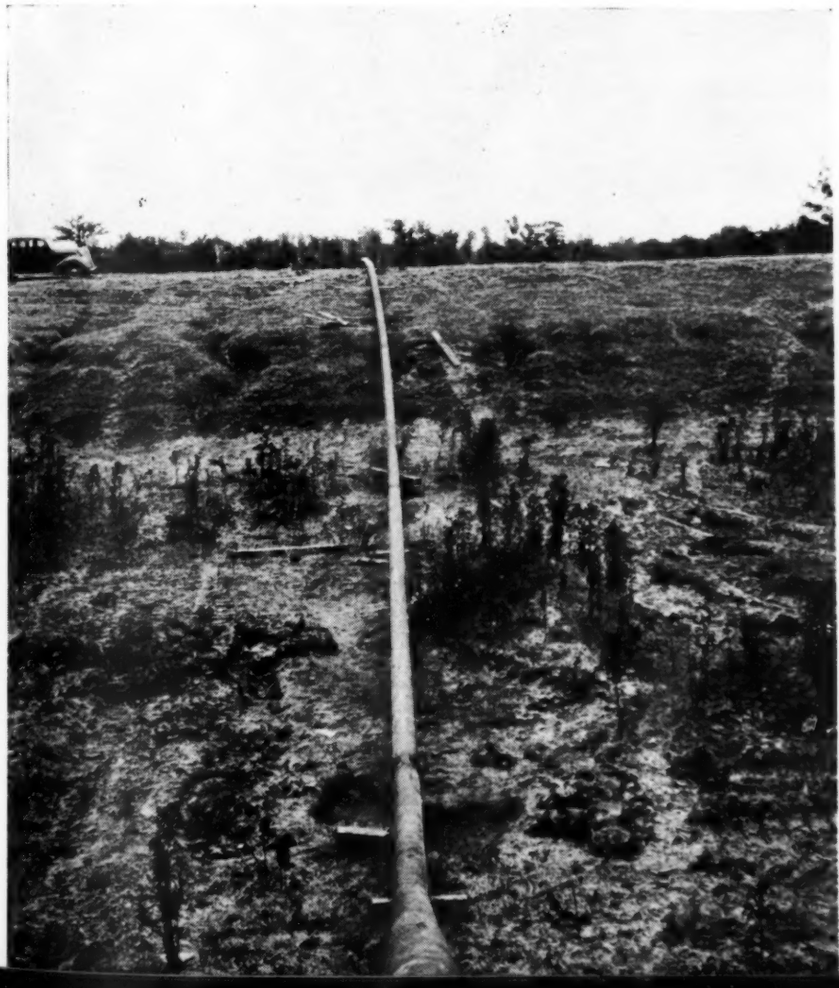
South Louisiana's Newest Pipe Line

except on approximately 32 miles of the line where the area was so swampy that it had to be hand ditched. The machines each averaged about 10,000 ft. in 24 hours. The trench was cut shallow, allowing for two feet of covering in cultivated areas and one foot elsewhere, it being the policy of the Standard to lay their lines in this manner to avoid pipe corrosion.

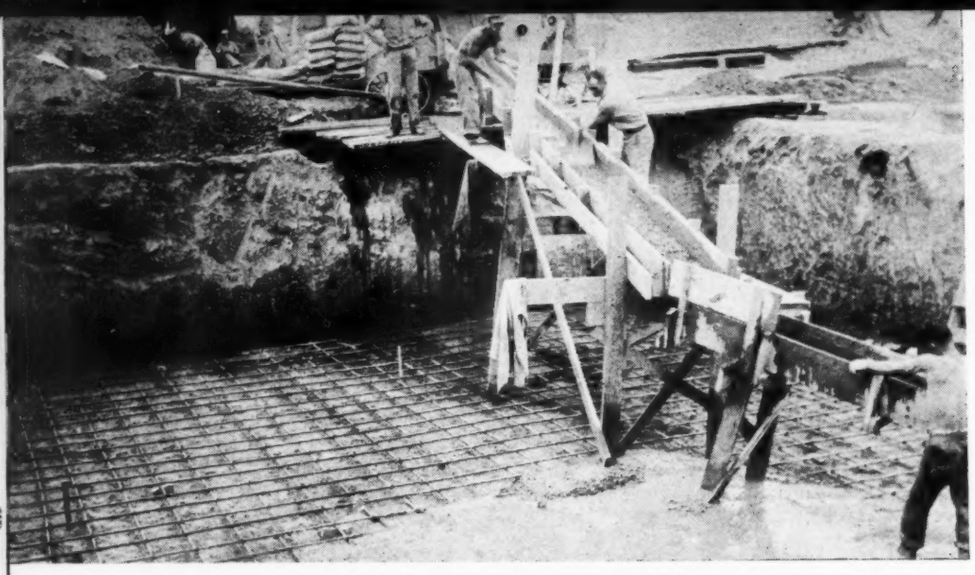
Electric welding was used throughout the line. For the most part the conventional method of roll welding was employed, but, as mentioned previously, approximately 25 miles of line through swampy country was laid by the stove-pipe method. As is well known, the use of this method has gained rapidly in favor during the last few years. It is not so fast as firing-line welding but is more suitable where the ground is soft, as in this instance. On this job the pipe was lined up on skids over the ditch, a single 40-ft. joint at a time, tractors being used. The joint first was tack welded, followed by the joint-welding, the pipe remaining stationary. The crew then moved on to the next joint and the procedure repeated. In lining up the pipe a space of approximately ⅛-in. was left between the pipe ends, and three beads were used per joint. An average of one and one-fourth miles of pipe daily was laid by this method, using two tackers and five welders on the 10-inch.

On the portion of the line that was roll welded an average speed of 1.4 miles daily was made, using one tacker and three welders on the firing line and two or three welders in the tie-in gang.

The most interesting water crossing, as well as the most difficult, was that across the Atchafalaya River at a point near Kratz Springs where the width is 1400 feet. This stream is swift and treacherous, its bed shifting frequently. In making the crossing the joints of pipe were welded into a complete string on shore, 1500-lb. river clamps placed every 40 ft., one end secured to a barge and the balance of the line swung under two other barges. In this manner the line was swung into position, with a slack curve upstream of about 300 ft., and lowered to the bottom of the river, which was 90 ft. in depth at the point of crossing. On each bank 300-ft. U-bends were installed, supported on 8-in. rollers. The purpose of these bends is to allow the line to feed into the river as the bot-



Line laid over one of the many levees



Pouring mattes at one of the pump stations

tom washes out and changes, preventing a break in the line. From experience of Standard officials in the past it is known that because of the peculiarity of the current and the extreme depth of the river it will be necessary from time to time to add sections of pipe to the bends as the river bed shifts and line is fed in.

On all river and bayou crossings a fabricated sleeve was used to reinforce the welded joints. The sleeve was made in two sections, grooved in the center to fit over the weld. The sections were welded together along the sides of the pipe where they meet and also welded to the line pipe at each end.

The entire line was coated with the regular application used by the Standard Oil Company, consisting of a heavy coating of grease, followed by an asbestos wrapper spirally applied, and another heavy coating of grease over the whole to relieve soil stress.

PUMP STATIONS

There are three principal stations connected with the newly-laid line. These are at Jeanerette, Roanoke, and Sunset. The Jeanerette and Roanoke stations, although in main line service, are of the type generally classed as gathering stations. Both stations have wood frame buildings covered with corrugated galvanized iron.

The Jeanerette Station contains three 100-hp. vertical multi-cylinder internal combustion engines operating on natural gas. Each engine is connected by V-belt drive to a 5 by 10 horizontal, double-acting, duplex pump. The Roanoke Station has approximately the same equipment except that it was designed for two units instead of three.

The Sunset Station is situated approximately one and one-half miles south of Sunset, Louisiana. It is the receiving point of two streams of crude oil, one of which originates at Jeanerette and the other at Roanoke.

This station consists of the main-line pumping plant, three 55,000-bbl. oil storage tanks, necessary piping and fittings for the handling of the crude, warehouse, outside storage of materials, and residences for station and field employees. The tanks and lines are so connected that the two streams can be received simultaneously and at the same time that the station is pumping one of them to Anchorage; or, in an emergency, one stream can be received while the other stream is being pumped through to final destination by the station of origin, Sunset Station being shut down. As this station will be the central headquarters for the entire South Louisiana division, there are six cottages with all modern conveniences for the married employees, two barracks for the unmarried, and a boarding house. Garages for the cars and trucks of the company and employees also have been constructed.

The engine and pump building is 50 ft. by 120 ft. and consists of a structural-steel frame covered with corrugated galvanized iron, with ventilated steel sash windows and rotary type ventilators on the roof. The engine and pump rooms are separated by a firewall consisting of a row of structural-steel columns down the center of the building, both sides of which are covered with corrugated galvanized iron. A double door vestibule in this firewall permits passage of employees from one room to another and the doors are so arranged that the two doors cannot be opened at the same time, thus minimizing the fire hazards and, in case of fire, confining the fire to the room in which it originates.

This building contains two main-line pumping units, suction pump, water pump, air compressor, and an engine-driven a-c. generator, together with shower baths and toilet facilities for the station employees. Each main-line pumping unit consists of a 300-hp. 20 by 34½, horizontal, twin-cylinder, internal-combustion engine operating on crude oil and directly connected through a flexible coupling to a 5¾ by 24 horizontal, double-acting, triplex pump (of 20,000-bbl. daily capacity) which, in turn, is directly connected to a 5 by 8 vertical triplex pump that circulates the cooling water for the engine jackets. Only one of these units will be in service; the other is stand-by equipment.

The jacket cooling-water system consists of a surge tank, an oil-cooled heat exchanger, and the circulating water pump. This pump receives the hot water from the surge tank, forces it through the heat exchanger and engine jackets to the surge tank.

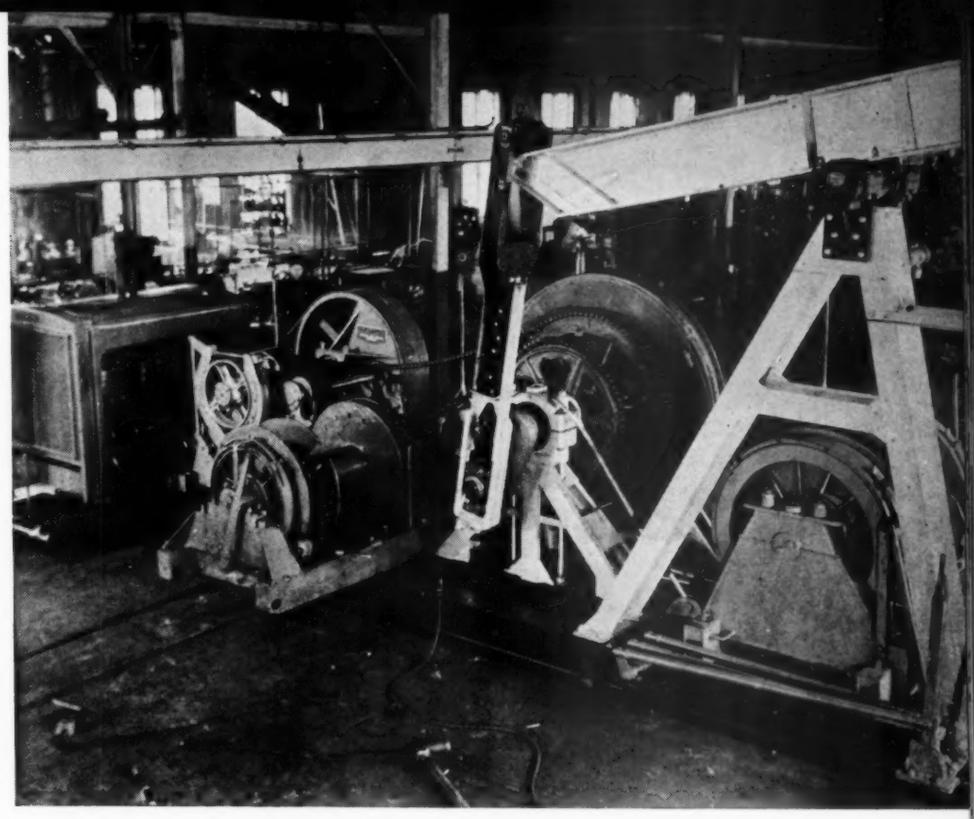
The other auxiliary equipment, consisting of the suction pump, water pump, compressor, and centrifuge, all is electrically driven and the power is supplied by a 70-kva., 60-cycle, 30-phase alternator connected by V-belt drive to a 100-hp. multi-cylinder internal combustion engine operating on crude oil. This equipment also provides power for station, residences, and lighting.

The oil suction pump is of the rotary type directly connected to a 15-hp. a-c. totally-enclosed induction motor. This pump is used to remove oil from the main pipe lines in case of a line break, aids in the transfer of oil from one tank to another should a tank become afire, and does various pick-up services around the station. The water pump is of the rotary type directly connected to a 10-hp. totally-enclosed induction motor and is used in connection with a gravity tank for supplying water to the residences, for fire fighting, and for the washing of station floors, etc.

The air compressor is used to supply the air tanks, used in starting the internal combustion engines, and in supplying air for lifting fresh water from the well into the gravity tank. The centrifuge is used in the reclamation of the used lubricating oil, all of which, except the engine cylinder oil, is trapped, piped to a dirty-oil tank, reclaimed, and returned to the clean lubricating tanks.

With this equipment and the design of the line between Sunset and Anchorage, there will be a daily capacity of approximately 20,000 bbl. into Anchorage.

Williams Brothers Corporation, Tulsa, Oklahoma, was the general contractor for the line. The Parkhill Truck Company, Tulsa, sub-contracted the stringing, and the H. C. Price Company, Bartlesville, Oklahoma, was sub-contractor for the welding. The stations were erected by the construction department of the Standard Oil Company of Louisiana.



Assembled unit in shop ready for testing

By

V. B. DALLAS

Efficient Drilling--In Rig Front Designed for Portability

Construction indicates trend toward combination unit for drilling-in wells and taking pumping potentials

IN the Mid-Continent rotary tools for drilling wells have practically supplanted cable tools except in a few shallow areas. It is interesting to note, however, that approximately 75 percent of the rotary-drilled holes are completed by cable-tool methods.

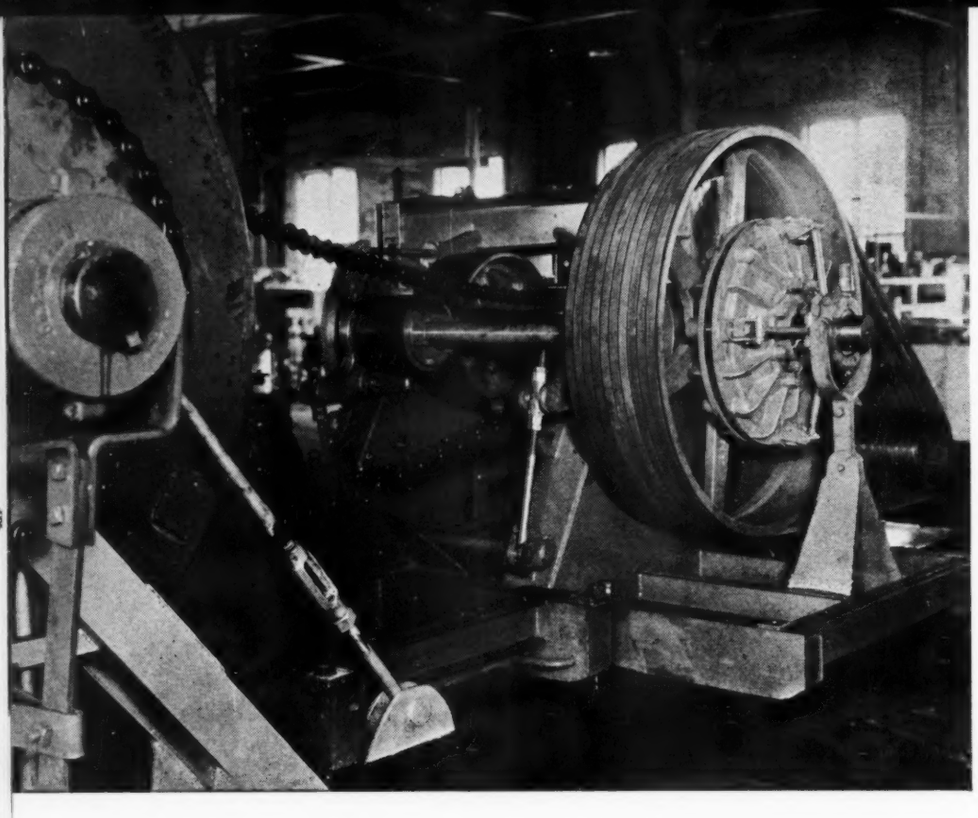
Originally this was accomplished by installing a standard wooden or steel front after setting and cementing the oil string. These installations were permanent and were converted for pumping immediately after drilling-in the well. The front generally served during the life of the well as a pumping system and a medium for well servicing and was convenient for use in subsequent well re-conditioning operations.

Since the introduction of individual pumping units, which allow a significant reduction in investment costs, the installation of permanent standard fronts for drilling-in purposes has been generally discontinued except in proven areas where conditions dictate the use of this type of equipment for permanent pumping application.

For speed and economy it became necessary to develop some type of a cable tool drilling-in machine that could complete a rotary-drilled well successfully and would be satisfactory for use in establishing a pumping potential. At first standard wood fronts were set temporarily for this purpose and steam was universally used for power.

The trend to portability and compactness was noticeable when steel bases were fabricated to support the engine, sand reel, jack posts, and sampson post. Many weaknesses were evident in the light types of drilling-in fronts of early design. The evolution of the design of these light fronts to some of the rugged, compact machines now in use is fraught with interesting developments.

There are at present a number of general layouts being used. Still popular is the simple steam-driven front just described, having the base made to take the sand reel and steam engine. The steam engine is usually situated ahead of the jack posts and alongside the sampson post. A vertical sampson post is used most generally, because this type of portable front does not interfere with the derrick floor or sill installation. This type also is identified by the use of a conventional tug for driving standard bull wheels, the tug being mounted on the crank shaft. From this steam-driven front, the newer multi-cylinder engine drive was developed. The same type of sampson post and bull-wheel drive is used but the base is extended to support a reversible countershaft and multi-cylinder engine mounting. Because of the excessive length of this base, it may be made in two sections, the front supporting the sampson post, jack posts, and sand reel, and the rear supporting the power and countershaft. The latest type is more or less a combination of the two types described, except that the base is designed to support a production hoist, which replaces the bull wheels. Because the production hoist base interferes with the regular derrick floor and sill arrangement, it is preferable to use an "A" frame or tripod sampson post. This type of sampson post, of



Drive from engine to master clutch and from clutch to main crank shaft

course, is more satisfactory than the vertical-type post. The "A" frame post and production hoist-type front make a more rigid, compact, and hence a more readily portable, unit.

One of the latest types of these units recently has been constructed for use in Kansas where it is common practice to drill in with a portable cable tool unit and where unusually heavy pumping potentials are encountered in many wells.

This front was designed for maximum portability. The working parts are mounted on a steel base that is in direct contact through adjusting screws with the steel base, on which is mounted a large multi-cylinder engine. It has been possible to skid the entire unit from one location to another in two sections. When being moved any appreciable distance the complete unit is handled by two five-ton trucks, only the walking beam and the bull hoist being dismantled. Normally the operators can start bailing mud from a rotary drilled well within six hours after the main base is skidded onto a timber foundation. Tearing out and dismantling for moving require about four hours.

The main working parts of the front consist of: bull hoist for handling drilling and casing lines, sand reel, reversible master clutch, main crank shaft, heavy sampson post, short steel walking beam, and a 150-hp. multi-cylinder engine.

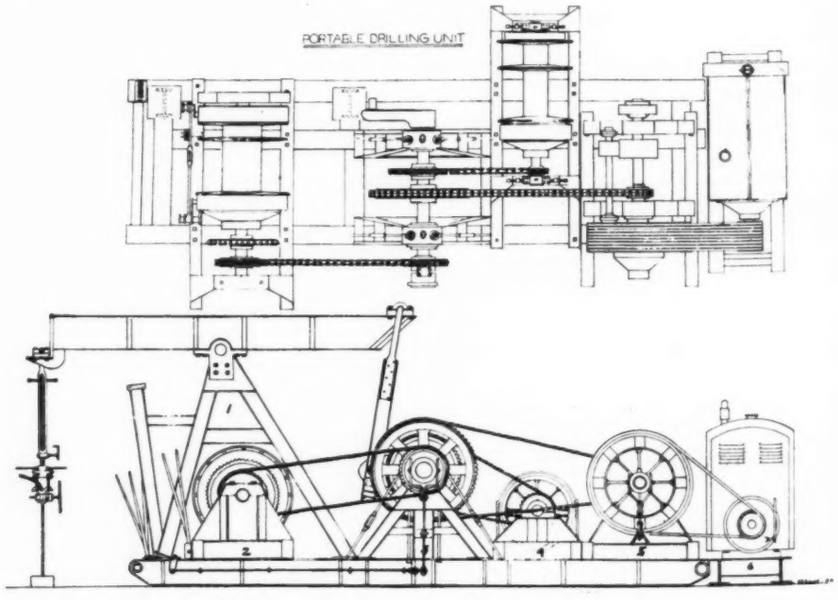
Probably the most outstanding features of this front are the specially-designed beam, sampson post, and pitman.

Walking Beam

The walking beam is unusual in that its working centers are considerably shorter than those conventionally employed. The front end of the beam is underslung and is fabricated to take a straight-lift wire-line horsehead hanger for use in determining pumping potential. The back end is slotted, making the beam reversible. This makes it possible to use the standard temper screw when more clearance over the well head is required. The beam is made of 18-in. by 11¾-in. C. B. section 96 lb. per ft. carbon steel. It has overall working centers of 16 ft. with the front and back end symmetrical at the approximate center line, and is calculated to have an A.P.I. capacity exceeding 22,000 pounds. The saddle trunnions are 8½ in. in diameter and 5¼ in. in length, have a bearing area of 44.6 sq. in. in each side-iron bearing, and are enclosed in an oil-bath lubrication system.

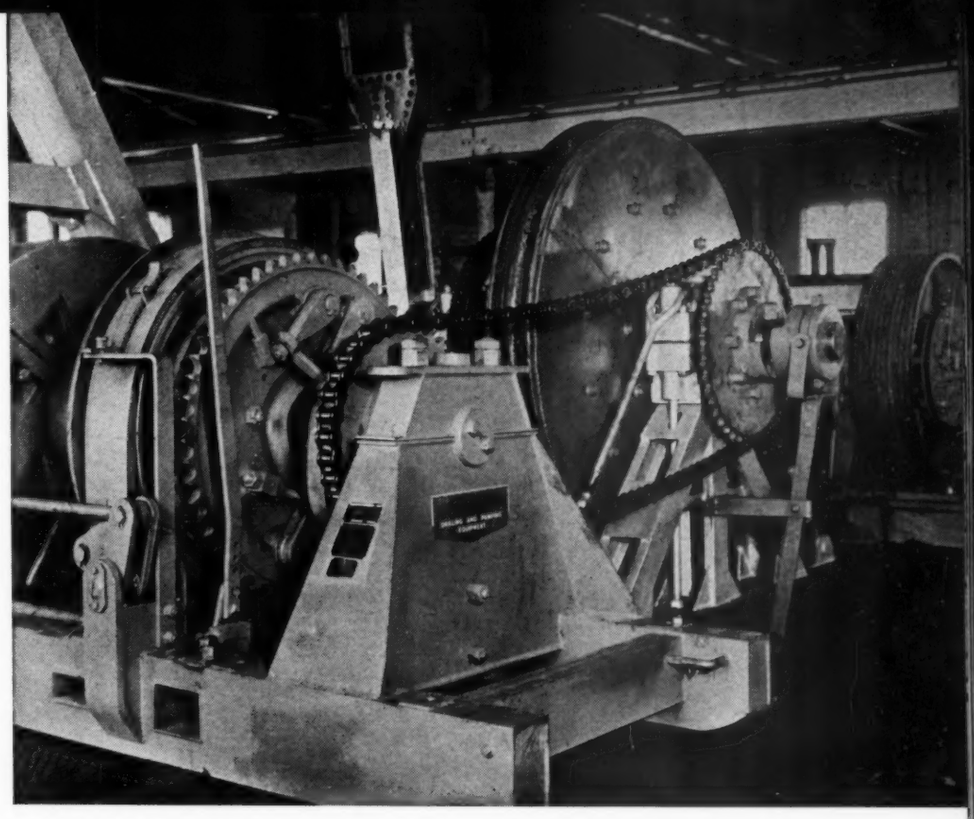
Sampson Post

The sampson post is made of 14-in. by 6¾-in. C.B. section carbon steel. The vertical height from the bottom of the base plates to the center line of the side-iron bearing is 10 ft. 6 inches. The sampson post is of "A" frame type. The front leg is 2 ft. 8 in. ahead of the center line, and the back leg



Sketch of portable drilling-in unit showing arrangement of main operating parts

1. Sampson post assembly
2. Bull hoist
3. Main crank shaft assembly
4. Sand reel
5. Reversible master clutch
6. Multi-cylinder engine



Showing drive from main crankshaft to bull hoist. The square-jawed clutch actuates the hoist drive sprocket. By removing this drive sprocket from the shaft and replacing with a regular A.P.I. calf wheel drive sprocket the front is converted into a conventional standard drilling front

5 ft. 8 in. behind the center line. It may be seen that this deviates considerably from conventional sampson post construction. The short working center beam naturally allows the use of a very short sampson post, and the unsymmetrical design was adopted for two reasons. First, it is necessary to provide ample clearance for the bull hoist. Secondly, and of greater importance, the unsymmetrical "A" frame places the back sampson post leg as close to the jack post as posible so that its down-load, when in compression, would best resist or compensate for the up-load, or the tensional pull on the front jack post. Considerable bending of the relatively unsupported section between the sampson post and the jack post on many fronts mounted on steel skids has caused a great deal of trouble in the past. In addition, carrying a large portion of the load on the back sampson post leg eliminates the tendency for the front end of the unit to "dive" down at the up-stroke of the walking beam, which also was a common trouble with previously-designed units. The sampson post legs are bolted through welded base plates to the main skid base with 1¼-in. machine bolts. An 8-ft. by 6½-in. C.B. 24-lb. steel headache post is fitted to the sampson post front leg.

Pitman

The pitman has been designed with working centers of 8 ft. 5 inches. The stirrup is made of 6-in. 15 lb. per ft. car channel and is reinforced at all bend points to eliminate bending in the reins. The stirrup bearing is the spherical, oilbath, self-aligning type; the spherical feature allows easy handling of the pitman, particularly in moving it past the back sampson post leg. The pitman beam is 10-in. 23-lb. C.B. section and has a solid cast-steel head and boomer type wrist pin bearing clamping blocks, which facilitate quick attachment to and removal from the wrist pin. The wrist-pin bearing is lubricated by an oilbath and is bronze bushed, and accommodates a 4-in. by 6-in. wrist pin.

Base

The main base skid is fabricated from 14-in. by 10-in. flange 61-lb. C.B. section steel and 12-in. by 10-in. flange 53-lb. C. B. section steel. The 14-in. by 10-in. steel is used in the longitudinal sections and the 12-in by 10-in. steel is used for cross members. There are three 14-in. by 10-in. by 25-ft. beams, and six 12-in. by 10-in. by 7-ft. beams used in the main base. These base members are ribbed with vertical reinforcements at intervals to minimize bending or vibration tendencies, and the entire substructure is electric-welded. The engine base consists of two 14-in. by 10-in. by 10-ft. sections having 6-in. drill pipe cross members.

Bull Hoist

The bull hoist eliminates the need for the conventional bull wheels and calf wheel. Under normal operations the hoist is used for handling the drilling line, but it can be converted easily into a calf wheel for handling casing by skidding it a few inches to one side and applying the chain drive to the 56-tooth sprocket instead of the 34-tooth sprocket that is used when handling the drilling line.

This hoist surpasses bull wheels in flexibility, speed, safety, and capacity. Its 6½-in. stationary shaft, supporting a 20-in. steel spool, rolls on tapered roller bearings. The spool is 37 in. long and is equipped with flanges that are 54 in. in diameter. Ample braking capacity is obtained through the use of two 48-in. diameter brake drums having a width of 8 inches. The spooling capacity of the drum, without dividers, is 7000 ft. of 1-in. line; 9000 ft. of ⅞-in. line, and 11,000 ft. of ¾-in. line. It has not been necessary to remove the line from the hoist when moving the unit; this is a time-saving feature.

Master Clutch

The master clutch is the gearless, reversible, friction, single-belt type, and is mounted on steel skids. It is equipped with a driven pulley 56 in. in diameter and 15 in. wide, grooved for ten D-section V-belts. This clutch has a capacity of approximately 100 hp. at 100 revolutions per minute. The shaft has a diameter of 5⅛ in. and a length of 92 inches. It is equipped with a special heavy clam shell neutral brake that is controlled from the driller's position. This brake is capable of stalling the engine in case of emergency application. The rotating shafts and the clutch pulley are supported on roller bearings. The forward and reverse mechanism is operated by a single derrick lever. This friction reverse type clutch provides the internal combustion engine with a reverse equiva-

Unit in operation drilling-in a well in Reno County, Kansas. After the drilling-in process is completed and tubing and rods are installed, the wireline horse-head hanger will be attached to the front end of the beam and a pumping potential taken

lent to that of a steam engine in flexibility.

Main Crank Shaft Assembly

The main crank shaft is 6½-in. in diameter except for a 12-in. extension on the calf wheel end that is turned down to 6 in. to accommodate standard A.P.I. calf-wheel irons. The overall length of this shaft is eight ft., and a standard 4-hole A.P.I. crank reamed out to 6½ in. is fitted to the crank end. Key-ways are cut to accommodate the crank, main drive sprocket, sand reel drive sprocket, tug rim, and calf wheel clutch. The drive is transmitted from the master clutch to the main crank shaft by means of a 19-tooth double sprocket on the clutch and a 94-tooth double 2-in. pitch steel sprocket on the crank shaft. The calf wheel clutch engages a 44-tooth, 2½-in. pitch sprocket that drives the bull hoist. The tug is a standard 7-ft. diameter, metal-type rim not used in connection with the front unless for some reason it is desirable to install bull wheels and remove the bull hoist.

The crank shaft turns in roller bearings that are supported by two 3½ ft. high "A" frame steel jack posts. These posts are electric-welded to the main base skids and are reinforced at the bottom. Both posts are equipped with tie-down rods and diagonal turnbuckle braces. If it is desired to convert the front into a standard cable-tool drilling rig, the 44-tooth, 2½-in. pitch drive sprocket for the bull hoist is slipped off the shaft and replaced with a standard A.P.I. calf-wheel clutch sprocket. In this manner, by removing the bull hoist and making use of the tug rim, a standard front with bull wheels and calf wheels can be rigged up easily in case it is desirable to do so.

Sand Reel

The sand reel is the conventional chain-driven, air-cooled type. It is equipped with a heavy double disc clutch having a capacity of 1 hp. per revolution per minute. A safety brake is provided in order that the reel may be stopped if the derrick lever can not be used in case of emergency. The 5½-in. diameter shaft supporting the sand reel drum is mounted on two heavy roller bearings, and is driven by a 23-tooth 2-in. pitch sprocket. A neat metal cover was designed to provide safety and to eliminate the throwing of oil and mud on the engine. (See accompanying illustrations.)

Engine

The power used for driving this unit is provided by a 6-cylinder 6-in. bore by 7¼-in. stroke, gas-gasoline standard drilling engine. The engine has 1230 cu. in. piston displacement and is rated at 150 hp. at 850 revolutions per minute. Its speed range is 500 to 1000 r.p.m., delivering 87 to 164 hp. within these limits. A complete 12-volt electric starting system is used including electric starter, generator, ammeter, and starter switch. The engine is equipped with natural gas cylinder heads and blocks, cast in pairs, allowing their easy removal. The use of an Ensign combination natural gas or gasoline carburetor makes it possible to use either of these fuels in the engine, only a minor adjustment of the carburetor being required for a quick change-over.

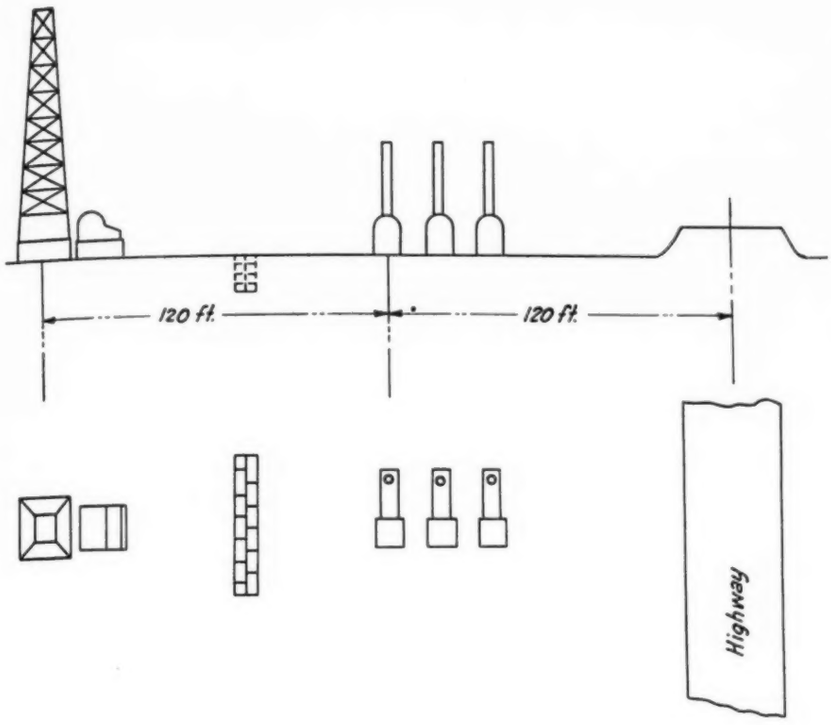
Natural gas consumption is approximately ten cu. ft. per b.hp-hr. when operating on 1000-B.t.u gas. When using gasoline in the natural gas heads, the fuel consumption is approximately 0.64 lb. of fuel per b.hp-hr. at 1000 r.p.m. under full load. High test Ethyl gasoline is required when operating the natural gas heads on gasoline; however, it rarely has been found necessary to use gasoline, as an ample supply of natural gas ordinarily is available on drilling-in jobs when following a rotary.

A heavy-duty power take-off and clutch is used, the shaft extension of the power take off being 3 15/16 in. in diameter and 10 in. long. The shaft is fitted with a 10-groove, 14-in. pitch diameter, D-section V-belt pulley. This pulley overhangs the clutch bearing about 3 in. and by reducing the leverage on the clutch bearing, improves the bearing operation. The engine and the power take-off are mounted on a heavy steel skid base, as previously described.

In checking the performance of this engine it has been determined that all requirements of a flexible power unit for drilling-in, swabbing, and taking pumping potentials have been provided.

Most producing companies who operate their own tools are adding portable drilling-in fronts to their equipment. More compact, portable, and efficient fronts are gradually being evolved as mistakes are corrected and improvements and refinements added. Drilling contractors have sensed this trend and have had many exceptionally efficient portable drilling-in units designed and constructed. In areas where heavy pumping potentials are encountered this type of equipment has an advantage.

In this unit the sampson post assembly was built by the Lee C. Moore Company of Tulsa, Oklahoma; the bull hoist, counter shaft clutch, sand reel and jack post assembly by the O.C.S. Manufacturing Company of Coffeyville, Kansas; and the engine by the Buda Engine Company, Harvey, Illinois. The main skids were constructed, the entire unit assembled, and controls installed by the Bridgeport Machine Company at their Wichita, Kansas, headquarters. The unit was designed and its construction supervised by V. D. Bennett, production engineer, for the Derby Oil Company. Bennett is now with the British American Oil Producing Company with headquarters in Tulsa.



Elevation and plan sketch of drilling layout, showing approximate location of baled hay "vibration muffler" that stopped damage to highway and boiler setting

By
CHARLES C. LYNDE

A simple expedient by which excessive movement is confined to the immediate vicinity of the drilling well

Damping Rotary Rig Ground Vibration

WHILE drilling a projected 6000-ft. wildcat in a tidal flat on the Gulf Coast, the ground level of which is but a few inches above the normal range of spring tide levels, men working around the rig soon noted the pronounced vibration of the ground, especially when the drawworks was being run rapidly, as when pulling cores.

Little notice was taken of the vibrations other than to comment on them until a steam line on No. 2 boiler cracked. Checking showed that, although set properly on their cribbing at the time of rigging up, all three boilers leaned noticeably, the inclination of the stack in each case being toward the derrick. The steam line trouble was corrected by introducing two more elbows in each line between steam dome and header, so that the boilers could shift through a considerable arc without imposing a strain on the pipe or fittings.

When the well had reached about half the contracted depth the contractor, parking his car on the highway instead of plowing through the mud to the actual drilling site, noted a pronounced quiver to his rear-view mirror, although the car motor was shut off. Further investigation showed that the "black top" surfacing of the state highway showed a set of parallel ridges extending lengthwise, a section at the edge being broken off and lower than the rest of the pavement.

Failing to find any of his geophysicist friends to observe the vibrations that he felt were causing the progressive subsidence of the highway, the contractor obtained a 10-lb. bottle of mercury and with a platter improvised an artificial horizon. When bedded in damp sand on the road surface, the reflecting plane of the mercury registered the vibrations set up by the rig, those caused by drilling being of much higher frequency and less magnitude than those set up by the drawworks. These latter showed first as plainly visible waves marching progressively across the fluid surface, but the edges of the platter served to reflect the waves and cause interference.

Believing that these disturbances, instead of being seismic and deep-seated, were largely, if not almost wholly, surface manifestations, he directed that a ditch be dug across the lease, directly between the rig and boiler setting, perpendicular to a line joining them and about 80 ft. from the well itself. This ditch, although filling quickly with water, was bailed down as well as possible, and a wall of hay bales, two wide and with joints broken after the fashion of brickwork, was built up in the hole. Scrap pipe was piled across the bales to keep them from floating out of the trench, and to prevent trucks from inadvertently becoming bogged down at the site.

With the hay-bale dike in place, the drawworks again was raced at top speed; only the faintest shadow of vibrations was detected to ruffle the surface of the artificial horizon on the mercury bath.

No further subsidence around the boiler settings was noted, and the ridges set up in the highway became no worse as drilling progressed, although as the depth increased the drilling load likewise became greater, and the vibration around the well became even more marked than during the earlier stages of the work.

So marked was the dampening effect on vibrations through surface soil that when a second location was to be drilled, on a site similar to the first, the digging of a trench and the building of a hay-bale "muffler" was one of the first jobs to be undertaken, even before actual drilling had started.

The experience of this contractor would indicate that deep drilling is not to blame for most of the destructive vibration noted — and the basis for damage suits—in congested areas. Instead of the vibrations being imparted to the earth by the rotary through the drill stem and bit, the trouble originates in and is transmitted by the rapidly-rotating portions of the drawworks, which act, as would any other heavy piece of unanchored machinery, to set up tremors in the ground immediately below it. These tremors or vibrations are transmitted horizontally to a degree depending upon the character and condition of the terrain and the extent of the disturbances set up by the machinery. Whatever their extent, in most cases the vibrations may be effectively suppressed by some such expedient as that described.

Bureau of Mines Analyzes Crude Oil From New Ordovician Field In West Texas Permian Basin

THE crude oil produced from Ordovician lime in the Sand Hills field in western Crane County, Texas, is a wax-bearing paraffin-intermediate base oil having a gravity of 44.7 deg. A.P.I. and a sulphur content of 0.22 percent, according to the laboratory analysis made by the U. S. Bureau of Mines, Department of the Interior, on a sample obtained from Gulf Production Corporation No. 4 Waddell, sec. 4, blk. 27. A distillation summary indicates approximately 35 percent gasoline and naphtha, 20 percent kerosene distillate, and 25 percent gas-oil and heavier distillates suitable for cracking. The analysis of this oil compares favorably with previous analyses made by the Bureau of Mines on oil produced from the heavy-oil zone of the Ordovician strata in the Big Lake field, Reagan County, Texas.

The Sand Hills field is the second field to produce from the Ordovician strata in the West Texas Permian Basin—the first being Big Lake in Reagan County. Oil was discovered in the Ordovician strata in the Continental-Group One Oil Corporation, University No. 1-B in the Big Lake field, December 1, 1928. This well was completed at a total depth of 8523 ft. and produced 2,800,000 bbl. of oil prior to March, 1933, when it was temporarily shut down. Twenty-five wells drilled to the Ordovician strata in this field had a total production on January 1, 1936, of 23,000,000 barrels.

Several wells have been drilled in search of Ordovician pay in other parts of the West Texas Permian Basin, the most notable of which was the Gulf Production Corporation's McElroy No. 103 in the Church-Field-McElroy field, Crane-Upton counties, the deepest well in the world, to a total depth of 12,786 feet. No commercial production was found in the deeper formations and the well was plugged back to the 3000-ft. oil-producing limestone horizon.

Gulf Production Corporation's Waddell No. 4, from which the sample was obtained for analysis, was completed at a total depth of 6014 ft. in a dolomite, probably the Ellenburger formation. Although this was the third well to produce from the Ordovician strata in the Sand Hills field, it is the first important well and produces by natural flow. Two wells drilled previously had small initial production and are produced by pumping.

The approximate summary of the analysis of the crude oil is as follows:

APPROXIMATE SUMMARY

	Percent	Sp. gr.	°A.P.I.	Viscosity
Light gasoline	11.0	0.665	81.3	
Total gasoline and naphtha	34.8	.716	66.1	
Kerosene distillate	20.1	.792	47.2	
Gas oil	12.4	.833	38.4	
Nonviscous lubricating distillate	8.4	0.847—0.875	35.6—30.2	50–100
Medium lubricating distillate	3.9	0.875—0.887	30.2—28.0	100–200
Viscous lubricating distillate	.....	.....	.....	Above 200
Residuum	18.4	0.936	19.7	
Distillation loss	2.0	.....	.....	

The detailed analysis of the crude oil is given below:

General Characteristics

Specific gravity 0.803 — A. P. I. gravity 44.7°
Percent sulphur 0.22 — Color greenish black
Saybolt Universal viscosity at 77° F. 40 seconds.
Saybolt Universal viscosity at 100° F. 37 seconds.

Distillation, Bureau of Mines Hempel Method

Dry distillation — Barometer 744 mm. — First drop: 33° C. (91° F.)

Temperature °C.	Percent cut	Sum, percent	Sp. gr. of cut	°A.P.I. of cut	Viscosity at 100° F.	Cloud test °F.	Temperature °F.
Up to 50	2.8	2.8	0.641	89.3			Up to 122
50– 75	4.1	6.9	.656	84.2			122–167
75–100	4.1	11.0	.690	73.6			167–212
100–125	5.9	16.9	.714	66.7			212–257
125–150	6.0	22.9	.733	61.5			257–302
150–175	5.9	28.8	.749	57.4			302–347
175–200	6.0	34.8	.763	54.0			347–392
200–225	6.1	40.9	.777	50.6			392–437
225–250	6.3	47.2	.792	47.2			437–482
250–275	7.7	54.9	.805	44.3			482–527
Vacuum distillation at 40 mm.							
Up to 200	5.1	5.1	0.824	40.2	39	20	Up to 392
200–225	5.9	11.0	.834	38.2	43	35	392–437
225–250	5.2	16.2	.851	34.8	52	45	437–482
250–275	4.4	20.6	.869	31.3	74	60	482–527
275–300	4.1	24.7	.881	29.1	120	75	527–572

Carbon residue of residuum 6.8% — Carbon residue of crude 1.3%

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TRIMONT MFG. CO., INC.
Roxbury (Boston), Mass.

Quite frequently hills were so steep that the trench hoe had to be held by a tractor while digging the ditch

Diverse Conditions Encountered in Laying Gasoline Line

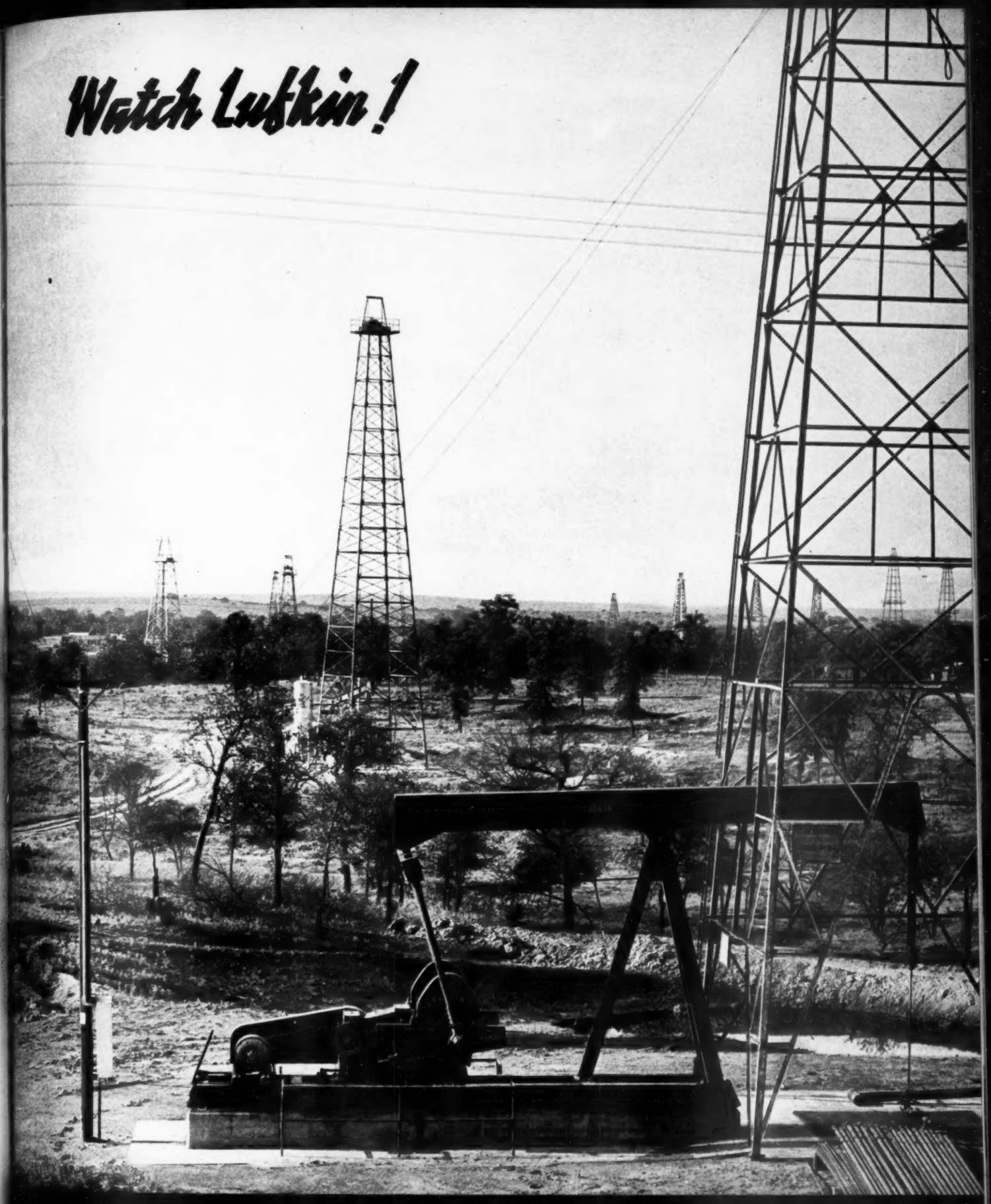
Description of methods employed in constructing 8-in. system for Williamsport, Pennsylvania, to Buffalo and Rochester, New York, for the Keystone Pipe Line Company and the Buffalo Pipe Line Company

By FRANK H. LOVE

THE Keystone Pipe Line Company and the Buffalo Pipe Line Company, transportation affiliates of the Atlantic Refining Company, have completed the laying of their 8-in. gasoline pipe line system in the East that now makes it possible for them to serve Buffalo and Rochester, New York, and also from those points to ship by water on the Great Lakes. The new carrier is an extension of the Keystone Pipe Line Company's system, tying-in to the latter at Williamsport, Pennsylvania, and extending to Buffalo, New York, a distance of approximately 210 miles. At Caledonia, New York, the line branches and goes to Rochester, a distance of 20 miles.

In laying the line varied conditions were encountered in respect to topography, the right-of-way being through mountainous areas, timbered land, swamps, and farm lands. From Williamsport to a point near Geneseo the terrain was rough and rocky. In some parts of Pennsylvania it was necessary to do considerable blasting in order to make the ditch. Where blasting was resorted to trenching was with a power-driven back hoe and by hand. In addition, there was much timberland and mountainous country throughout Pennsylvania and some farm land through which the line passed. Although in New York State the line was across mountains and through land heavily timbered, it was possible to do practically all the ditching by machine, the formation being mostly loose rock, gravel, and large boulders. From the junction at Caledonia to Buffalo and Rochester considerable swamp land was encountered in the valleys and flat lands.

The topography of the country presented certain difficulties in the matter of stringing, welding, and the laying of the line in general. In many instances, in the hilly country, it was necessary to back-string the pipe either on the tops of mountains, on shelves on mountain sides, or level places at the foot of mountains in order to provide a level and convenient place for


Watch Lufkin!

Laying pipe through a swamp land area in New York State

lining up and welding. In instances where the pipe was back-strung on mountain tops or mountain sides the 40-ft. joints were welded into 200-ft. sections and pushed down the incline. A like section was then welded on and the procedure repeated until the end of the pipe string had reached the bottom of the mountain or the next level place. At all such spots where the pipe had to be back-strung careful measurements were made, and as a result there never was any great surplus or shortage of pipe.

The mountains and hills also presented another difficulty. In certain instances the incline of the ditch was so great that it had to be riprapped, either by stones or wooden poles being placed at convenient distances, to prevent the backfill from being washed by heavy rains.

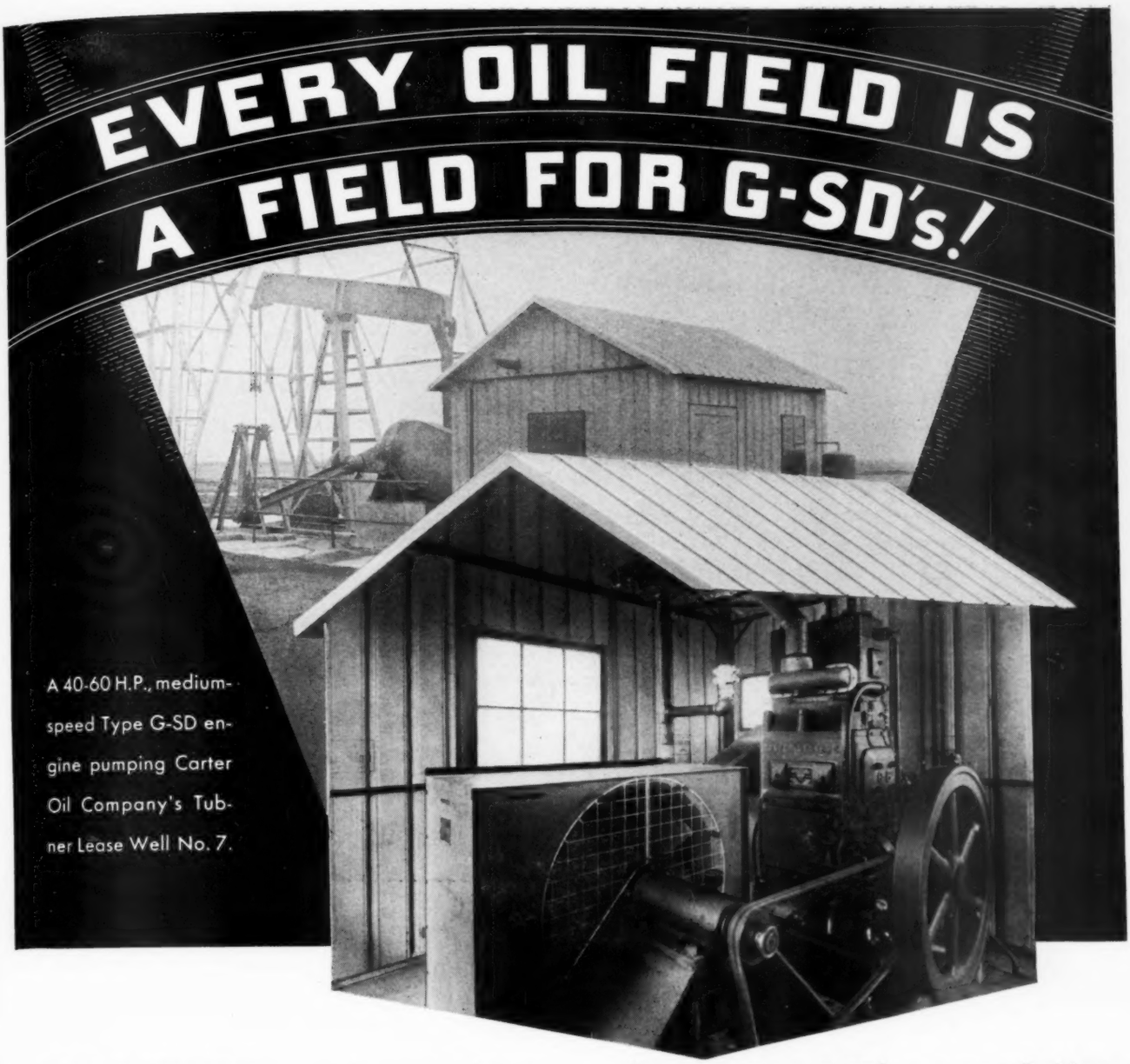
The pipe was received at convenient points along the line in 40-ft. joints and was transported to the job and strung by means of trucks and tractors equipped with winches. A special tin cap devised by the Atlantic Refining Company was placed over the ends of each joint to keep the interior of the pipe free from dirt and other foreign matter. The caps were not removed until the joint was to be welded into the line.

All welding was by the electric method, the 40-ft. joints being roll welded into 200-ft. sections. Double-bell pipe was used and the welds were backed up by chill rings.

During the course of construction numerous railroads and highways were crossed, as well as three rivers. The latter were the Chemung River, near Big Flats, New York, the width at the point of crossing being 350 ft.; the Genesee River near Geneseo, New York, a 200-ft. crossing; and the Susquehanna River near Williamsport, Pennsylvania. The latter was the widest and most difficult crossing, being 1000 ft. in width. The laying of this crossing was in direct charge of Ralph O'Neal of the Keystone Pipe Line Company, and in making it the pipe was laid from barges. On one side of the main barge was constructed a runway sloping at an angle of approximately 20 degrees. On this the joints of pipe were placed for welding into the line and for installation of the river clamps. As the barge was pulled from beneath the pipe the line was lowered into the river and new joints welded on, the procedure being continued until the river was crossed. The main barge contained, in addition to the runway, a power-operated winch and various other equipment. Line pipe was carried on a smaller barge along-

Backfilling with a bulldozer. The method of riprapping to prevent washing also can be seen

EVERY OIL FIELD IS A FIELD FOR G-SD's!



A 40-60 H.P., medium-speed Type G-SD engine pumping Carter Oil Company's Tubner Lease Well No. 7.

PRODUCTION MEN everywhere — Michigan to Texas, New York to California — see in Cooper-Bessemer Type G-SD pumping engines two main advantages:

First — These compact 40-60 horse Verticals cut down costs of investment, hauling, installing, housing — enable operators to get wells on the pump in the quickest time.

Second — Type G-SD's are a profitable investment because they are built to outlast the fields they pump — any Well equipped with one of these medium-speed, heavy-duty engines is *powered for the first and last time!*

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Dredging a trench across a narrow river

side the main one, and still another barge carried enamel and the other coating materials.

In making the narrower river crossings power hoes and drag lines were employed to dredge a trench for laying the pipe four to five feet beneath the bed. Pipe used on all river crossings was given several applications of hot enamel coating and two wrappings of paper that had an enamel covering. River clamps weighing 600 lb. each were spaced on the pipe approximately every 20 feet. On each side of the rivers gate valves were installed.

Under highways and railroads the 8-in. line pipe was encased in 12-in. pipe. The pipe on all such crossings was coated with hot enamel and paper, and before pulling into the casing a ½-in. rope was wrapped spirally about it to prevent damage to the coating and wrapping.

It was not deemed essential to coat with hot enamel all the line after a soil analysis made over the entire right-of-way revealed that only in certain areas were the soils corrosive. Consequently through these "hot spots" the pipe was given a priming coat, two coats of hot enamel "ragged" on in the field, and one wrapping of paper. The remainder of the line, other than river, highway, and railroad crossings, of course, was painted with a cold paint.

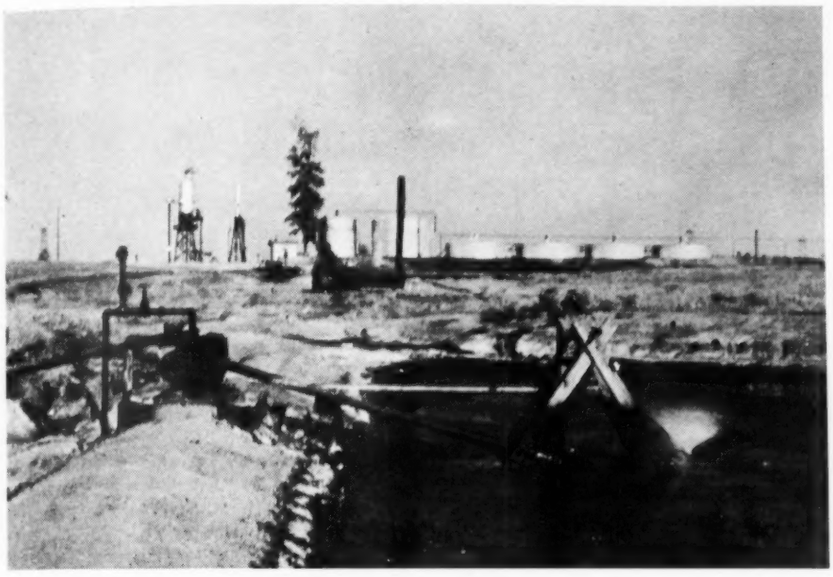
Testing of the line was with 100-lb. air pressure, in sections varying in length from 1500 ft. to 4000 ft., depending upon the topography of the country. Laps were left open on high points to make the line flexible and insure sufficient slack. These sections were tested, lowered into the ditch, and backfilled, final tie-ins at the laps being made the following morning. The bell holes were not filled in until after the line was completed and tested in its entirety with an air pressure of 100 pounds. This made it possible to inspect each of the tie-in welds for leaks. Railroad, highway, creek, and river crossings were tested in sections prior to being welded into the line.

Jones and Hanrahan, Dallas, Texas, were the general contractors for the entire line, and they also did the welding. On the Pennsylvania end of the line George Bonge was chief supervisor and W. E. Stainbeck was assistant supervisor. Both of these men are with the Keystone Pipe Line Company. On the New York end of the line W. S. Schmidt, of the Buffalo Pipe Line Company, was chief supervisor. Harry Ratchford and Son, of West Nanniecoke, Pennsylvania, sub-contracted the stringing.

Making a tie-in weld by the electric method

(Right) Flow tank battery, on Sinclair-Prairie Amanda Wiley farm, near Wright City, in the East Texas field, is used to separate gas from the oil, and the oil from the salt water

(Below) Pond in which salt water is accumulated after being separated from oil. The water is pumped from this pond to disposal system a short distance away. Sinclair-Prairie Oil Company, Amanda Wiley Farm, Wright City, Texas



Present Salt-Water Separation and Disposal Methods Used in East Texas Field

By M. J. GOODNIGHT

Surface evaporation utilized to dispose of large volumes of water produced by lease on west edge of field

EXACTLY when the East Texas field will produce salt water in sufficient volume to justify a unit disposal system is not known definitely, but enough water is being produced with the oil at the present time to cause concern. From the time the field was discovered until April 1, 1937, a total of 2595 wells had become water producers, most of them making water from the Woodbine sand. Pumping wells making water October, 1936, numbered only 850, according to the Oil and Gas Division of the Texas Railroad Commission, but by April, 1, 1937, the number had increased to 1518, an increase of almost 80 percent. At that time the Woodbine sand was producing more than 50,000 bbl. of salt water daily, and the volume increased rapidly during the summer of 1937.

Water has been pumped into salt water sands with varying success; to continue this practice the water must be conditioned and filtered to prevent plugging the face of the sand. Some operators, not adopting the underground disposal method, have built evaporation dikes and terraces to handle water, and have reported much success. Subsurface water is travelling from west to east through the field, and as the bottom-hole pressure falls because of excessive withdrawals, more wells are affected daily. On September 16, 1937, there were 23,535 wells in the field, every one of which may eventually produce salt water in varying volumes.

Separating the water from the oil in the East Texas field is not very difficult, as the greater portion of it drops out in the primary water separators. Stripping the water from the oil so as to produce pipe line oil requires heating in some instances, with the addition of compounds to accelerate settling. Numerous operators have constructed devices for separating oil and water as they are pumped from the well. They are placed between the tubing head and the oil and gas separators. The Magnolia Petroleum Company has constructed near Gladewater some of these oil and water separators, which were made by using a joint of large casing, welded at both ends and provided with eight risers at regular intervals along the upper side. Each riser is connected to the next downstream by a horizontal pipe attached below the upper end. Each riser is somewhat higher than the preceding one. The last and highest riser, which is the oil and gas outlet, connects to the lead line running to the flow tank battery and gas separators. The unit rests upon pipe supports imbedded in the soil, and flared at the lower ends to insure stability. Water separated from the oil and gas flows, or may be drained regularly, from the large diameter pipe, through pipe of adequate size to disposal.

Near Wright City, the Brogan Oil and Gas Company has constructed separators similar in operation, but somewhat different in design. Instead of utilizing a single large diameter pipe,

(*Continued on Page 68*)

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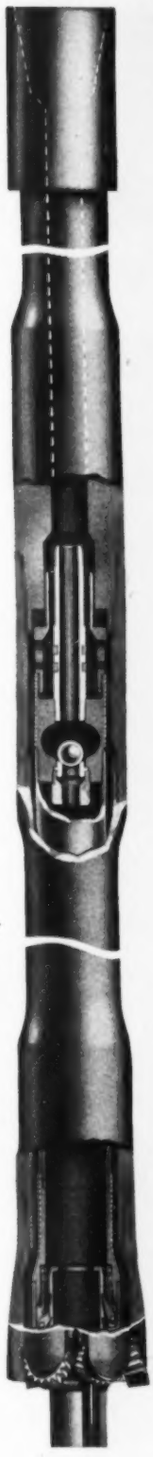

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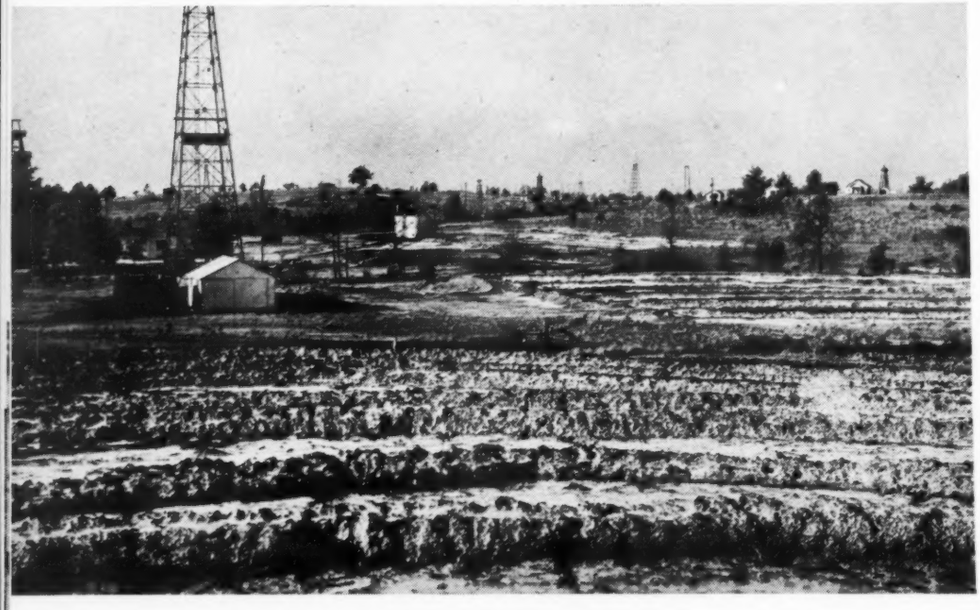
Reservoir into which salt water is pumped from the collecting pond, and from which it is allowed to flow at a predetermined rate to the evaporating terraces on the side of the hill. Sinclair-Prairie Oil Company, Amanda Wiley Farm, Wright City, Texas

(*Continued from Page 65*)

this company has made use of two, one above the other and connected at each end and by two risers near the center. The entire unit is supported upon concrete piers, the entrance end being above the level of the outlet end. The unit is wider at the outlet end than at the point of entrance of the oil, gas, and water, so the lower pipe section will drain easily to the water outlet, yet permit the upper, which carries the gas and oil, to be almost horizontal, the outlet end being slightly higher than the inlet. Gas and oil leave the separator at the highest point in the unit, and flow directly to the oil and gas separator, mounted directly above the flow tank battery. Several different types of these oil and water separators may be found throughout the field, each representing individual ideas, but all operating on the same principle.

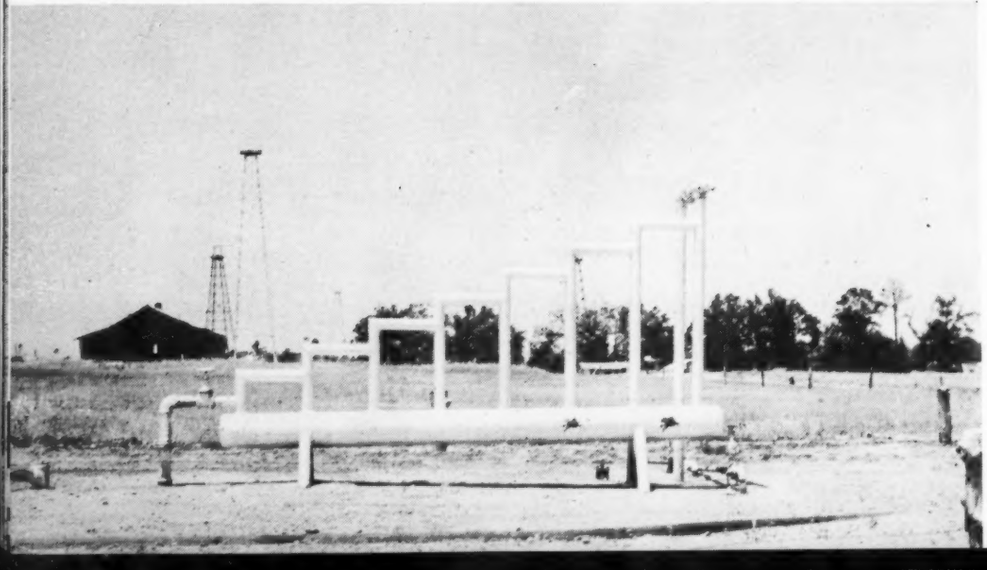
Some leases that produce large quantities of water, several times greater in volume than the allowable oil production, make use of several tanks centrally situated upon the lease, into which the oil and water flow after the gas has been removed, and in which separation is effected. On the west side of the field, almost on the western edge of the productive area, the Sinclair Prairie Oil Company has a lease upon which there are 13 wells, all producing water in varying amounts. Water is removed in a manner somewhat different from the usual. All the wells pump directly to an oil and gas separator, mounted upon an elevated structure so that liquids will flow easily from the vessel, consequently a very low pressure can be maintained on the system.

Two separators and six tanks comprise this field battery, three tanks being utilized for processing the oil and



Part of the system of terraces used by Sinclair-Prairie Oil Company, on the Amanda Wiley Farm, East Texas field, for salt water disposal by evaporation

water and the other three tanks constituting regular field storage, or flow tanks. The production of oil, gas, and water flows to the first separator, entering the vessel through a tangential nozzle, and the free gas flows out through the upper connection to the gas-gathering system leading to a gasoline plant. Water and oil pass from the separator to the first tank in the series of six, where free water settles out readily and is withdrawn through siphons to waste-water lines. The oil



Water and oil separator used by the Magnolia Petroleum Company on one of its wells near Gladewater, Texas

containing sediment and water in suspension passes from this tank to the third, a low 250-bbl. vessel, and from there it is pumped through a steam-

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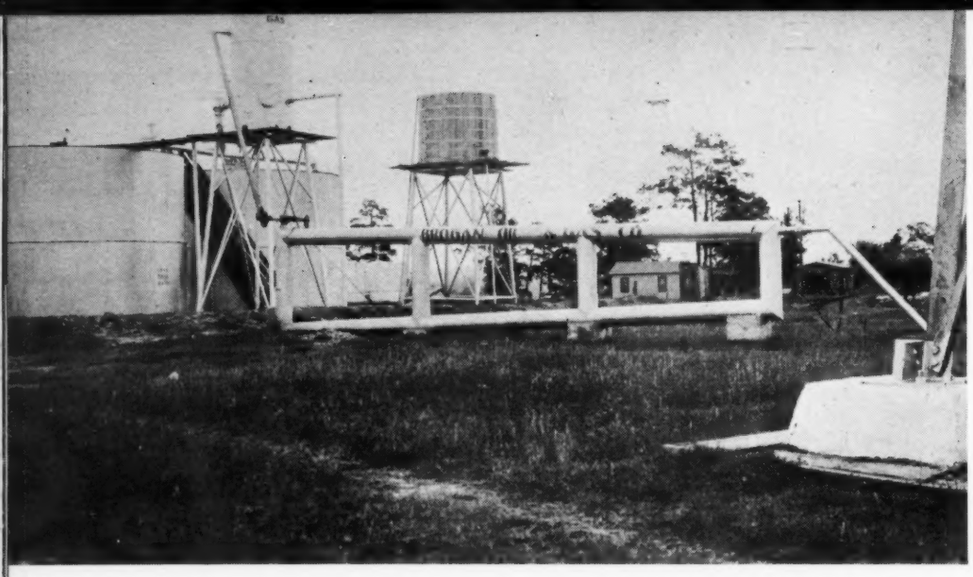
As Williamsport Wire Rope becomes Bethlehem Wire Rope, customers of Williamsport Wire Rope Company can look with assurance to Bethlehem to maintain the quality standards associated with Williamsport products. Advantages to the user may naturally be expected to accrue from the broader manufacturing and servicing facilities offered by the Bethlehem organization.

Customers of Bethlehem Steel Company can now obtain a complete line of wire rope and strand from the same source which furnishes their other steel requirements, and made to the same quality standards as those that govern in the manufacture of Bethlehem alloy and tool steels, plates, sheets, and other products.

Wherever and however you use wire rope and strand you will find Bethlehem a source of well-made, dependable material, serviced by men whose long, first-hand experience in analyzing and solving wire-rope problems is a background for authoritative recommendations on the most suitable grade of Bethlehem Wire Rope for any task.

BETHLEHEM STEEL COMPANY



Water and oil separator on Grogan Oil & Gas Company's property near Wright City

operated oil heater. The heater is a unit made of small diameter pipe within joints of large pipe and is placed upon the surface of the ground. Heated in this unit to the temperature considered sufficient for efficient separation of water, the fluid flows to the second tank in the line, where final settling is accomplished. Water flows out through siphons to a common disposal system that collects the water produced on the lease. Steam for pumps and the oil and water heater is obtained from an ordinary oil-field boiler.

A large pond, provided on the lease by damming a small gully nearby, contains sufficient storage space to take care of the water for several days; however, the water is pumped continuously from this reservoir to the disposal system, also constructed on the lease, and the water disposed of by evaporation. A large knoll near the center of this property was utilized, the rounded top being excavated to form a distribution pond, into which the water is constantly pumped from the collecting reservoir, which is situated down-stream from the flow tank battery and separating tanks. All sides of the knoll were plowed to form a succession of terraces into which the water gradually flows to be evaporated. The system of terraces begins at the top of the knoll, and they gradually lengthen toward the base of the hill as they follow its contours. From this point terraces continue across more level land, constituting several thousand feet of evaporating surface and permitting the water not evaporated to flow back to the collecting reservoir on the lower side of the lease.

The system of channels is constructed with a fall so slight that the water takes many hours to flow from the entrance ditch to the outlet canal. Practically all the water is evaporated during hot, dry weather, and the residue running into the drainage canal is remarkably free of salts. It tastes slightly brackish, practically no salt remaining. Crystallization of the salt occurs while the water flows slowly through the maze of disposal channels, and the heavier portions drop out and cling to the sides of the ditches, which, in the bright sunlight, appear to be covered with snow. The amount of water produced from the 13 wells on this lease varies from day to day, but the evaporating system is said to be sufficiently large to take care of the volume easily. As in most fields, more water eventually will be produced from each well in an effort to obtain the maximum allowable quantity of oil, and at some time in the future this system probably will be merged with others into a large unit caring for many thousands of barrels of salt water produced from the Woodbine sand.

Construction and Operation of Internal Combustion Engine Depicted in Educational Film

"THE Power Within," a new two-reel silent motion picture film that depicts the historic development, construction, and operation of the modern internal combustion engine and operating parts of the automobile, is the latest addition to the Bureau of Mines film library, which now consists of more than 4000 reels that were shown on 100,342 occasions last year to an attendance of nearly 9,000,000 persons.

Reel one illustrates early experiments to determine suitable fuel for internal combustion engines — first with gunpowder and, after two centuries of research, achievement of success with gasoline. Animated drawings show the operation of the 4-stroke cycle of an automobile engine cylinder, and compare the intake, compression, power, and exhaust strokes of an engine using gasoline with the loading, ramming, firing, and clearing of a cannon using gunpowder. Animation also is employed to show the resulting smoother flow of power when the number of cylinders is increased. By the utilizing of quartz glass in place of the usual metal cylinder head of the motor, actual photographs were taken with a specially-designed camera capable of taking 5000 pictures a second, thus portraying the actual combustion and the burning of gases within the cylinders. Each part of the engine is depicted graphically in the first reel of this picture and its function illustrated in a manner readily understood.

Reel two shows by animated photography the assembly of every part of the engine, transmission, differential, and other mechanical parts that go to make up a finished automobile. The operation of gear shifting is explained by animated drawings, together with the all-important function of the brake system that plays such a large factor in the role of safety. The entire story, as portrayed in these two reels of educational film, is presented in a way that should be of interest and value to every car owner.

Copies of this film, in 16-mm. and 35-mm. size, are available for exhibition by schools, churches, colleges, civic and business organizations, and others interested. Applications for the film should be addressed to the Bureau of Mines Experiment Station, 4800 Forbes Street, Pittsburgh, Pennsylvania. No charge is made for the use of the film, although the exhibitor is expected to pay the transportation charges.

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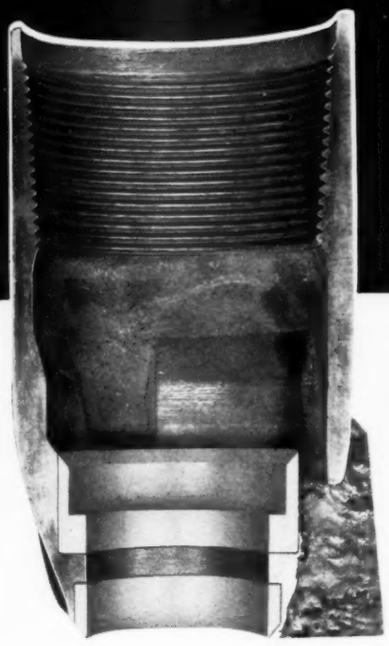

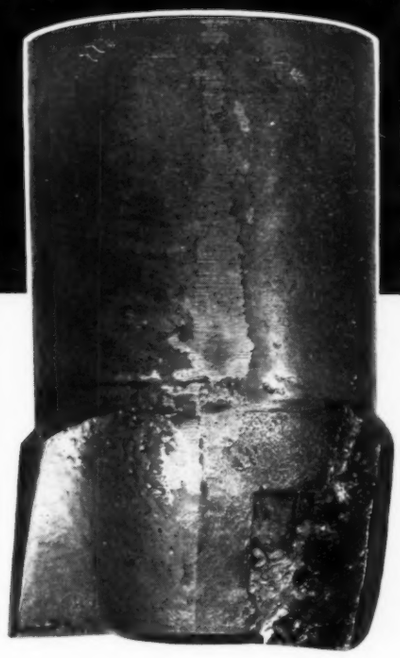

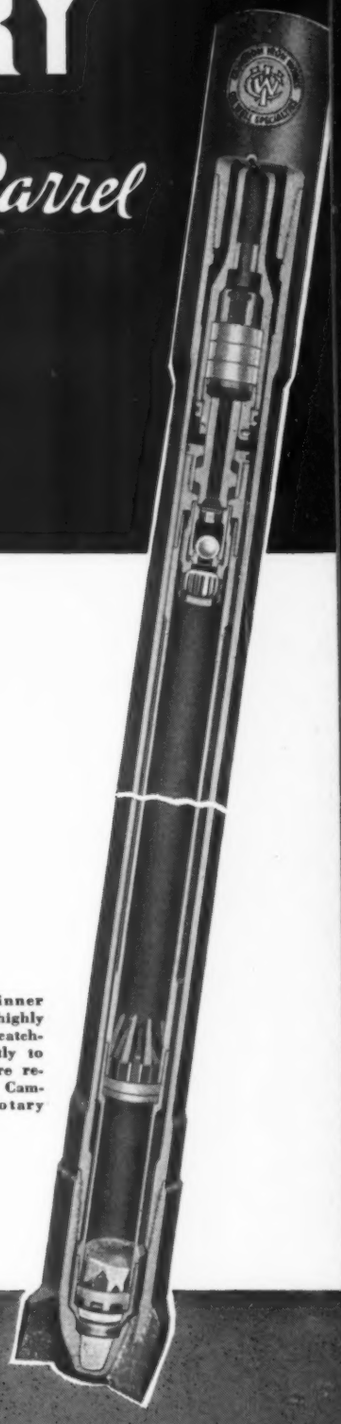

The non-rotating inner barrel, and the two highly efficient special core catchers, contribute greatly to the exceptional core recovery record of the Cameron Type "C" Rotary Core Barrel.

AS a precision instrument for recovering cores from any depth, no detail of construction of the Cameron Type "C" Rotary Core Barrel is left to chance. Precision dressing and re-dressing of soft formation core heads is an example. To assure cutting cores of exactly the correct diameter, a replaceable gauge bushing is welded in each core head. This bushing is replaced in our shops whenever wear exceeds 1/16" on diameter. To insure admission of precisely the correct amount of slush lubrication for cores being cut, a second replaceable wear bushing is welded inside each core head. This bushing is also replaced when wear exceeds 1/16" on the diameter.

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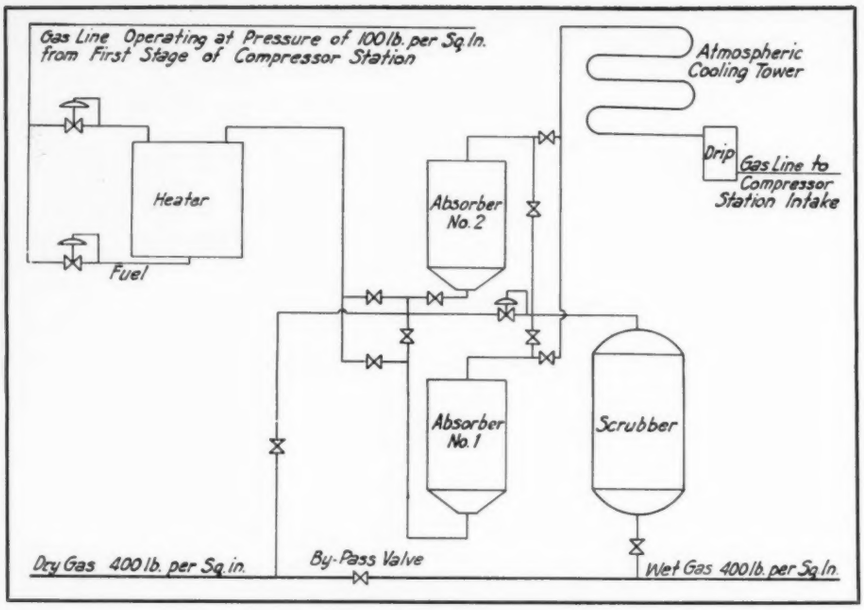
Gas Line Operating at Pressure of 100 lb. per Sq. In. from First Stage of Compressor Station
Atmospheric Cooling Tower
Drip
Gas Line to Compressor Station Intake
Heater
Fuel
Absorber No. 2
Absorber No. 1
Scrubber
Dry Gas 400 lb. per Sq. in.
By-Pass Valve
Wet Gas 400 lb. per Sq. In.

Fig. 8. Adsorption dehydration plant

By
JAS. R. COWLES

Part 4
(Concluded)

The Dehydration of Natural Gas

VII. ADSORPTION PROCESS

DEFINITION. Adsorption means the collection and holding of a gas or liquid by a surface. When gas is "dried," liquid is condensed from the vapor state. Agents used for "drying" gas have acres of surface per lb. of material. In some instances peculiar properties are observed that cannot be discussed here. In the case of silica gel it has been suggested that natural gasoline consisting of the heavier fractions could be recovered from the gas being treated at little additional outlay.[8]

Agents Possible.[17] Activated alumina and silica gel are the outstanding agents now commercially available. Allyne found silica gel to be the more suitable of the two; further, activated alumina is sensitive to hydrogen sulphide,[18] and it works best at temperatures lower than generally may be expected to be found. For these reasons the following discussion will deal with silica gel, though the principles are generally applicable. For illustrative purposes the plant designed by A. B. Allyne will be referred to. Fig. 8 is taken from his report.[h] The proposed capacity is 1,000,000 cu. ft. per hr. at a pressure of 400 lb. per sq. in (gauge), and at a temperature of 100 deg. fahrenheit.

Plant Cycle. All parts of the plant are not occupied with handling the gas at the same time. Essentially the gas goes through the scrubber; part enters one of the absorbers and the remainder is bypassed, as an excessive quantity of water would be removed if all the gas passed through an absorber. During this time the other absorber is being reactivated. A change from one absorber to the other is made at a predetermined interval.

Adsorption Period. Fig. 9 is presented as typical of the dehydrating action of silica gel. After reactivation the gel adsorbes all the moisture in the gas flowing through it for a period of about six hours. At the end of this time it loses efficacy rapidly. This fact is made use of in determining the adsorption period, automatic control not being feasible.

The fact that all the water is removed from the gas passing through the adsorber necessitates the bypass arrangement mentioned. As fairly constant conditions are anticipated this can be taken care of by an automatic bypass valve as shown in the flow sheet. This is so set that a definite fraction of the gas flows through the adsorber and mixes with the remaining gas before leaving the plant.

Reactivation Period. This is the period when the adsorbed water is removed from the adsorbers. Allyne proposes a four-hour period. During this time gas being dehydrated flows through the other adsorber. Reactivation is accomplished by heating gas to approximately 400 deg. fahr. and passing it through the adsorber. The hot moist gas is then cooled in an atmospheric cooling tower and then passed through a drip where the condensed water is removed. The gas then goes back to the compressor station to be put into the line again.

Cooling Period. The proposed period is one hour. Cooling is accomplished by blowing gas from the compressor station through the gel beds. The exact technique is not of concern here.

Conclusion. Yet untried, this method appears to be a good possibility until proven otherwise. Considerable discussion has been held about such a plant. Tables 2 and 3 giving estimated construction and operating costs are appended.

VIII. AMMONIA AS A HYDRATE INHIBITOR[10]

Other Inhibitors. Alcohol is used for the thawing out lines, though it is too expensive to be used as a preventive. Brines have a similar effect. Natural brines have been used in the field in the same manner as alcohol. In the Fritch Plant[i] calcium chloride brine is added in small quantities, being removed in drips after passing through the refrigeration system, to prevent hydrate formation in the plant. At a pressure of 575 lb. per sq. in. with temperatures from 35 to 38 deg. fahr. it was found that an 18 percent solution would prevent hydrate formation and remove any hydrates already formed. Anhydrous ammonia also has been found to be an inhibitor, and possess points of superiority to brines.

(h)—Such a plant has not yet been built so far as the author knows, chiefly because of the fear of contamination of the agent, or possibly its destruction by vibrations from compressors. However, until such a plant is tried on a large scale it is a method that cannot be overlooked. Experimental work has given no confirmation of the fears expressed above.

(i)—At Fritch, Texas, and owned by Texoma Natural Gas Company.

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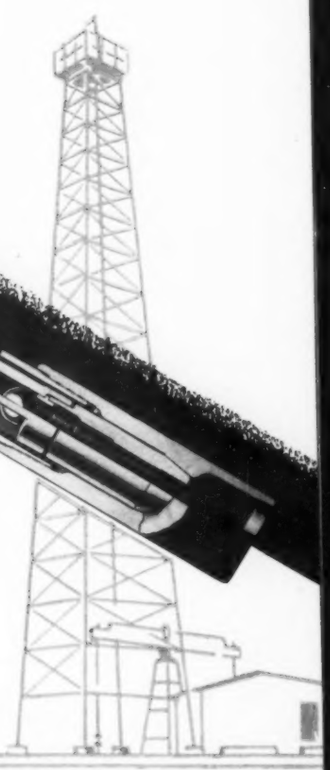
D+B liners are made from a special analysis high nickel content chrome alloy cast iron giving high strength and even texture. This material gives the greatest wear resisting qualities possible. Carefully lapped and polished, the wearing surface stubbornly resists the abrasive action of both fluid and foreign material.

The assembly of the ball bumper bushing and ribbed blind cage sleeve as shown constitutes a blind cage valve. The sleeves are designed to permit maximum fluid flow without sacrificing strength and involve integral ribs acting as ball guides, thus fulfilling the dual purpose of giving added strength and also guiding the ball. They are made of alloy steel, fully heat-treated.



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CONTINENTAL

Quantity of Ammonia Needed. At the present time 42 parts per million of anhydrous ammonia is used. This amounts to about two lb. of ammonia per million cu. ft. of gas (8-oz. base), costing at current price about $0.40 per 1000 M. cu. ft. of gas treated. This amount is well below the amount necessary to cause corrosion of any brass in a system.

Method of Adding Ammonia. Fig. 10 shows the general arrangement used. The liquid ammonia is held in a special tank, which is buried to keep the temperature nearly constant. By the arrangement of orifices a fixed fraction of the gas stream is made to pass through the ammonia container thus carrying a definite amount of ammonia gas into the stream. The orifice adjustments are made on the basis of analysis of down-stream gas using dilute sulphuric acid. Once set, frequent analysis should be made, and adjustments made as necessary. The system does not require a great deal of maintenance.

The ammonia is depleted in traveling through the system so that additions may be necessary at other points than the origin. This is particularly true if water and/or hydrates are present in the line.

Some difficulty has been experienced with a formation of ammonium bicarbonate in the small pipes connecting the tank. This appears to be due to excessive moisture and/or carbon dioxide in the gas flowing into the reservoir. In these cases it has been found advisable to add a drier (filled with solid calcium chloride) to the inlet line to the ammonia tank.

As the purpose of the large orifice is to obtain enough pressure drop to cause a flow of gas through the ammonia tank, a suggested alternative is the use of a pitot tube arrangement. Whether this could be easily made to regulate the quantity of ammonia introduced and thus eliminate the small orifice is not stated.

Conclusion. No detailed report is available on the results obtained though the method has been used several seasons and has been found satisfactory in weather as low as 15 deg. fahr. below zero with a line pressure of 750 lb. gauge. The method is cheap, both in initial and operating cost, and is well adapted to be used only when needed. Thus is appears that it has a very important place where the cost of a dehydration plant is not justified.

TABLE 2

Estimated Cost of Materials for An Adsorption Plant
1,000,000 standard cu. ft. per hr. 400 lb. gauge

One scrubber		$ 600.00
Two adsorbers		816.00
Four 8-in. plug valves		740.00
One gas heater		400.00
Four 2-in. gate valves 400-lb. w. p.		68.90
One 6-in. motor valve		200.00
Four flow controllers		325.00
One 2-in. pressure regulator		140.00
One gas meter 25,000 cu. ft. per hr. capacity at 35 lb.		189.50
One gas meter 400 cu. ft. per hr. at 2 lb.		13.75
One 2-in. regulator		24.75
Three 2-in. check valves, 400-lb. w. p.		40.80
One 2-in. relief valve		43.01
Three 12-in. gate valves, 400-lb. w. p.		570.00
150 sq. ft. cement paving and footings		50.00
One electric time clock and alarm system		150.00
Five 8-in. tube turns		77.60
Eight 12-in. flanged nipples		102.40
Twelve 8-in. flanged nipples		85.20
Miscellaneous fittings, etc.		200.00
Pipe		65.00
Total Materials		$4,901.91
Labor	$ 500.00	
Overhead (67 percent of direct labor)	335.00	
Total		835.00
One charge of silica gel, 3024 lb.		3,024.00
TOTAL INVESTMENT		$ 8,760.91

TABLE 3

Estimated Operating Costs and Fixed Charges for An Adsorption Plant*

Taxes	$ 148.70	
Interest on investment (7 percent of $8,760.91)	613.50	
Depreciation of plant equipment exclusive of silica gel (10-year life, 6 percent sinking fund)	452.20	
Total fixed charges		$1,214.40
Annual silica gel cost (complete replacement every five years assumed)	605.00	
Fuel	180.00	
Labor	1,095.00	
Supervision	200.00	
Total annual operating expenses		2,080.00
Total annual fixed charges and operating expenses		3,294.40
3,294.40		1234 1234 123444

$\frac{3,294.40}{5,480,000} = \$0.000601 = 0.6$ mills per M. cu. ft. = Estimated average cost of dehydrating.

*For capacity see Table 2.

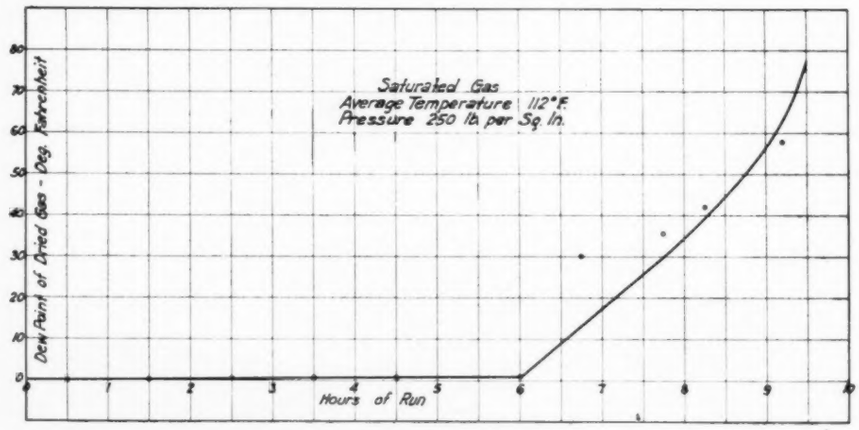

Fig. 9. Dew point of hydrated gas (silica gel)

CONCLUSION

The writer has been forced to the conclusion that at present the refrigerated brine plant is the only type likely to be built, on which cost data are available, hence no effort has been made to give costs per M. cu. ft. for the various plants. The average cost

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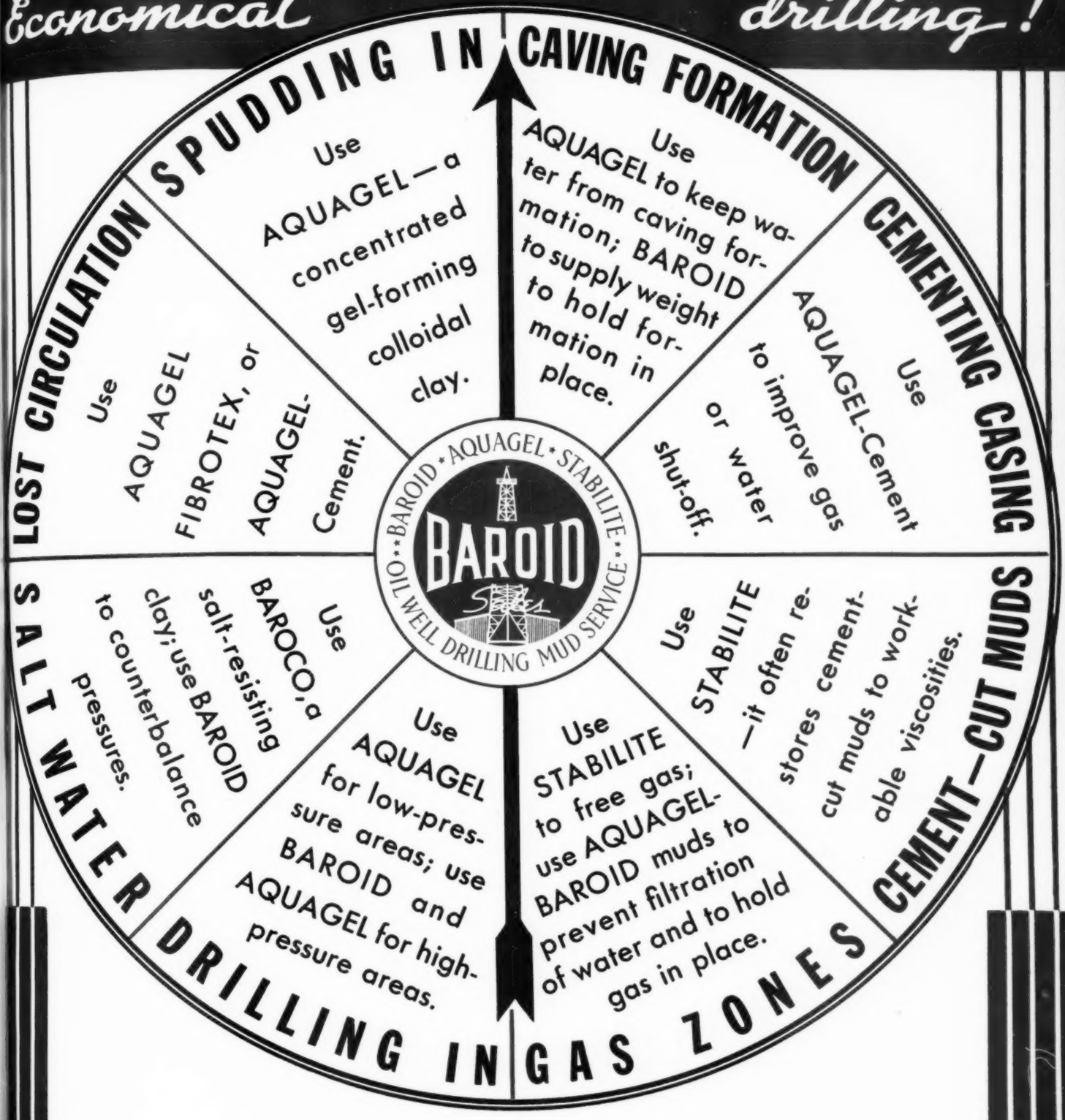
SPUDDING IN
Use AQUAGEL—a concentrated gel-forming colloidal clay.
CAVING FORMATION
Use AQUAGEL to keep water from caving formation; BAROID to supply weight to hold formation in place.
CEMENTING CASING
Use AQUAGEL-Cement to improve gas or water shut-off.
CEMENT—CUT MUDS
Use STABILITE—it often restores cement-cut muds to workable viscosities.
GAS ZONES
Use STABILITE to free gas; use AQUAGEL-BAROID muds to prevent filtration of water and to hold gas in place.
DRILLING IN
Use AQUAGEL for low-pressure areas; use BAROID and AQUAGEL for high-pressure areas.
SALT WATER
Use BAROCO, a salt-resisting clay; use BAROID to counterbalance pressures.
LOST CIRCULATION
Use AQUAGEL FIBROTEX, or AQUAGEL-Cement.
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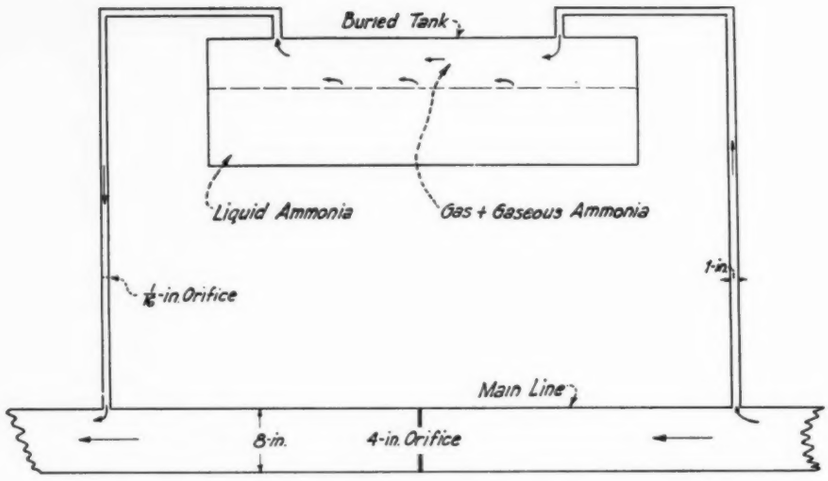

Fig 10. Method of introducing ammonia into line

runs around $0.005 per M. cu. ft., the exact amount being dependent on factors that vary for each plant.

The advantages of dehydration have given it, and the allied ammonia process, as definite a value as the natural-gasoline plant; however, these processes have limitations. For plain prevention of service interruption the ammonia process promises to be very satisfactory. Where the afforded economies of dehydration can be enjoyed to a greater extent, dehydration has proven itself to be quite practical. Of the generally applicable methods refrigerated brine plants enjoy the reputation of being the latest proven method. Absorption using diethylene glycol may prove superior as it is developed further, however. The adsorption system has not yet received a working-scale trial, though it also holds promise in future development.

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It is the author's opinion that the segregation employed is more desirable than the usual bibliographical form in that the subject has two phases, and that all the journals are not generally available.

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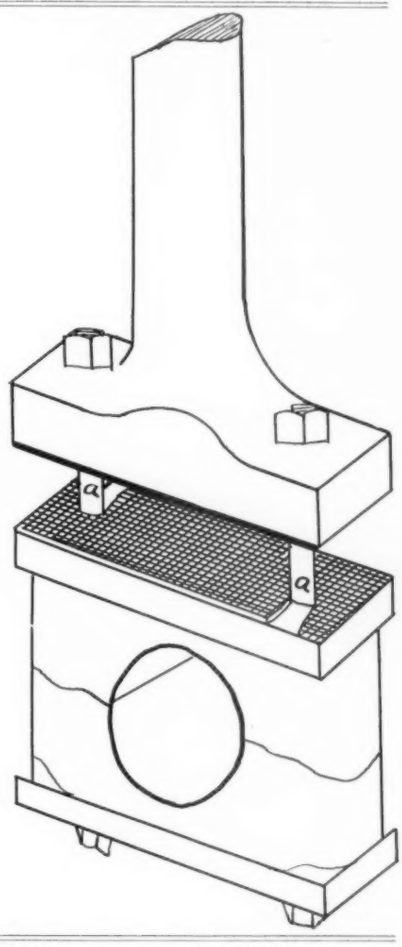
Changing Clearances by Shim Adjustments

By
J. L. INGRAM

HERE is a valuable kink that was given to the writer not long ago by a former chief chemist, whose specialty was boiler waters and boiler water treatment. No doubt many others will be glad to know about it.

The chemist stated that there is a really good and surprisingly simple test for oil in boiler water. Just clean an ordinary test tube, fill it to a depth of about two in. with the feed water you want to test and shake it for a few minutes with your thumb over the opening. If at the end of a sufficient period there is an accumulation of bubbles on the surface of the water you can be almost positive that there is oil and plenty of it in the water. The test is really quite sensitive, and one that any boiler operator can perform with amazingly accurate results. If at the end of the shaking period there is no evidence of bubbles at all, you can be reasonably certain that the amount of oil in the water is not sufficient to cause harm.



Inserting or removing shims without dropping crank-pin boxes

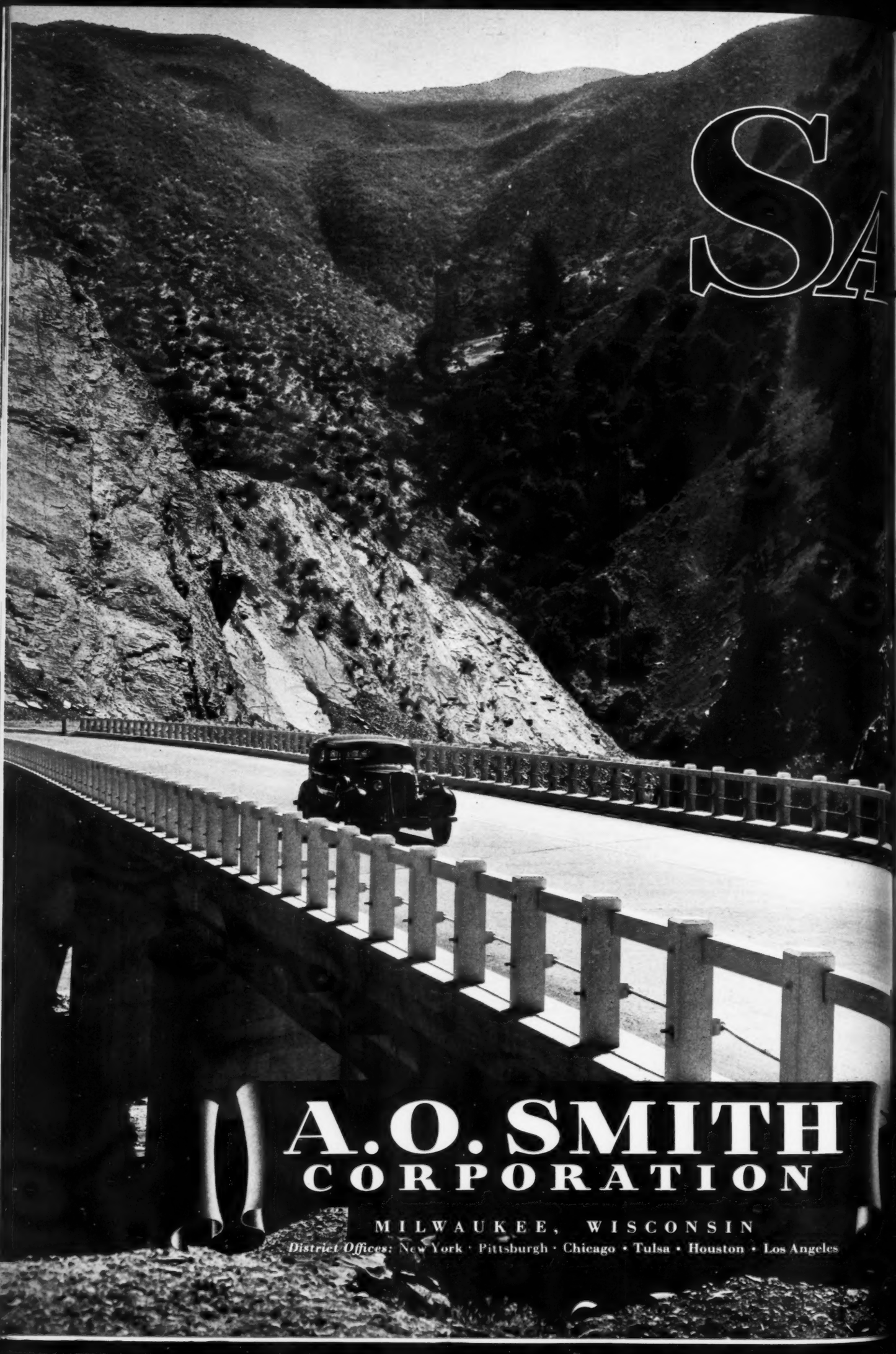
Simple Test for Oil in Boilers

By W. F. SCHAPHORST

WHEN the crank pin bolts of a large engine are to be removed from the holes in the lower end to permit taking out or inserting additional shims, much rigging and tackle is usually necessary, to mention nothing of the labor involved.

The only practicable method of adjusting piston clearance to determine the pressure at compression is to change the thickness of shims under the foot of the connecting rod.

If the bolt holes in the shims are slotted as shown in the accompanying illustration as many as desired may be taken out or inserted without dropping the crank pin box. The shims are inserted endways and revolved into position. It is suggested by the writer that no attempt be made to correct low compression by reducing clearances until a thorough investigation has been made to determine whether the loss of compression is due to leakage. Loss of compression in any engine that is due to wear is a gradual process.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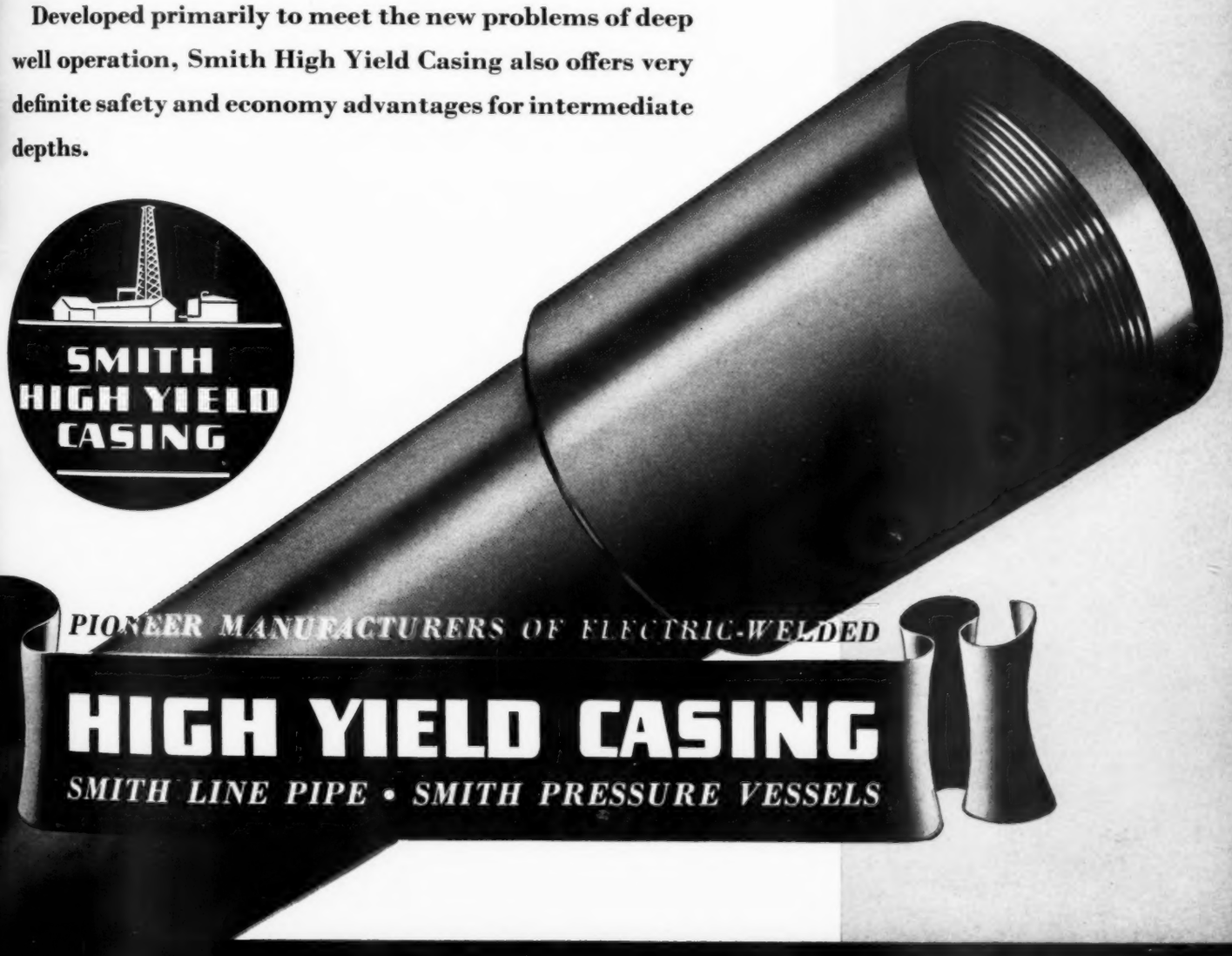

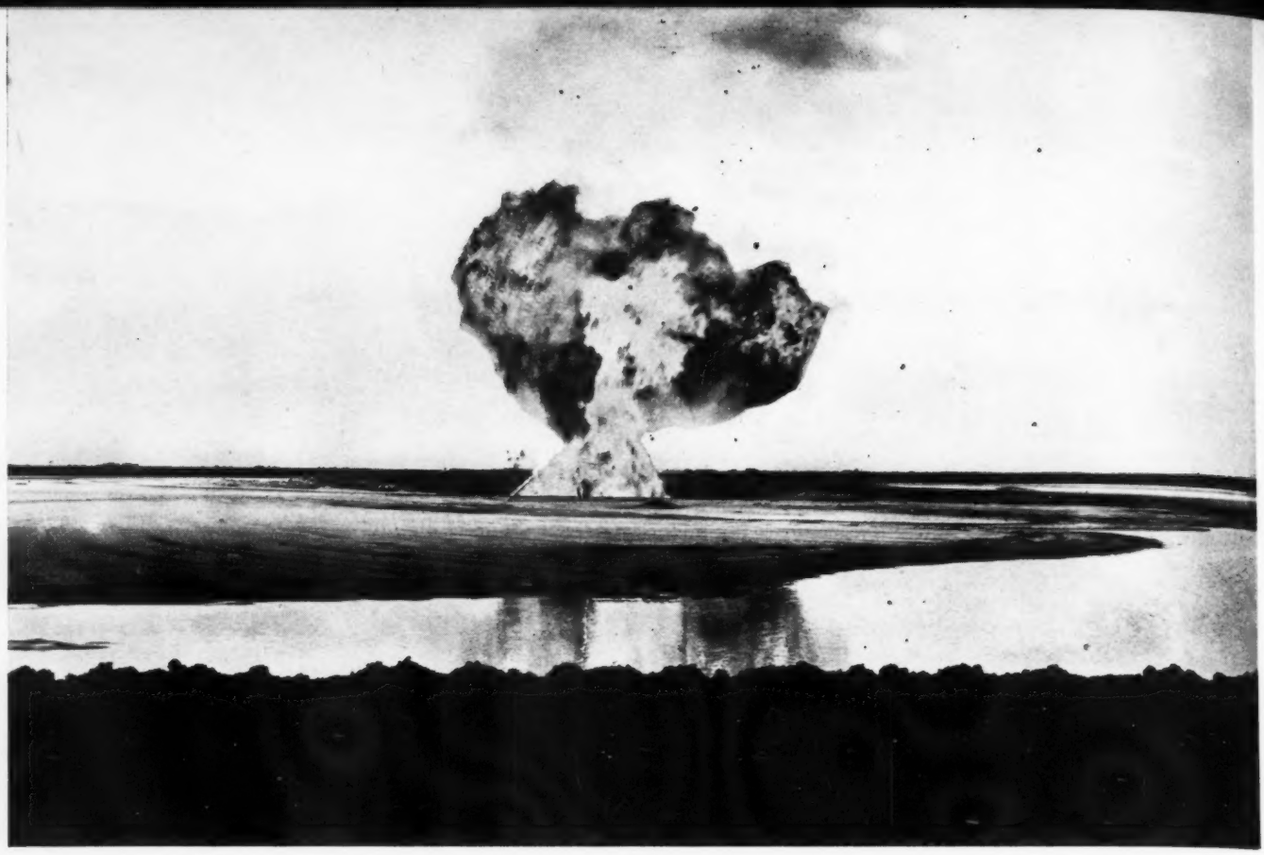

The burning well, surrounded by a sea of mud and water. Slush from the crater has inundated approximately 90 acres of rich farm land

» » » » Wild Well De f

By WILLIAM BLAKE

SCIENCE, it would appear, has come out second best in its fight to subdue the uncontrolled forces of nature in the Texon Drilling Company's No. 2 Driscoll Sevier, wild well in the Agua Dulce field, 35 miles west of Corpus Christi, Texas.

On November 19 the well will have been blowing and burning for one year at an almost undiminished rate.

During the past six months the cratering well has been allowed to burn unhindered but prior to that time the company spent thousands of dollars on almost every known method of control in an attempt to harness the tremendous gas pressures.

The wild well now consists of two craters, approximately 650 ft. apart. The main crater, or the one that formed around the well itself, is on fire, burning considerable gas and oil. It has extinguished itself several times but has been ignited again in order that the flames may vaporize the water and prevent it from spreading over the surrounding farm lands. The other crater is making only a small amount of water and a scum of oil but makes heads of gas that throw mud and slush high into the air. Continually growing, it is now approximately 150 or 200 ft. across and 30 or 40 ft. deep.

The entire area is encircled by a dike, eight to ten ft. high and about a mile and a half long, enclosing approximately 90 acres of land, all of which has been flooded and built up by mud and slush from the two craters. The volume of water and mud ejected by the well was so great that the first dikes, which were five ft. high and enclosed an area 1000 ft. square, were insufficient to hold back the slush, necessitating the construction of the present barriers. Construction costs of the dikes have exceeded the value of the two draglines used.

Not long after the well blew out, company officials, seeing that it was useless to attempt any other method for controlling it, decided to drill a relief well in an attempt to penetrate the old hole or to mud off the sand from which they believed the well was receiving its tremendous supply of gas. Accordingly the No. 2-B Sevier was spudded in 800 ft. due north of the crater. A conductor string of 16-in. casing was set at a depth of 270 ft. and cemented to the surface, and 10¾-in. casing was set at a depth of 1455 feet.

The relief well proceeded cautiously, whipstocks being set at 1675 ft., 1691 ft., 1763 ft., and 5225 feet.

Upon reaching a depth of 5876 ft., the drill pipe became stuck and approximately 30 days were required to clean out the hole. The well was then drilled to 6350 ft., where 7-in. O. D. casing was set and cemented.

After allowing the cement to harden for a sufficient length of time, plugs were drilled and the well cored to a total depth of 6465 ft., encountering a gas sand from 6415 to 6462 feet. Two-inch tubing was then run to bottom, the hole washed clean, and the gigantic task of attempting to kill the burning well was begun.

A battery of 6-in. by 18-in. slush pumps was set up. Three boilers were

required to supply sufficient steam for their operation. Operations were begun by pumping in 40,000 bbl. of clear water at a rate of 500 bbl. an hour. The initial pressure was thereby reduced from 2250 to 1500 pounds.

At that time it seemed that efforts to subdue the wild well were going to meet with success. Flames from the burning crater died down and the flow of mud and water decreased considerably. In an effort to deal a mortal blow, 5000 bbl. of heavy mud was pumped through the relief well into the sand.

All this proved to be of no avail, however, as the cratered well began burning and blowing with renewed vigor. Operations were resumed and for the next five weeks clear water was pumped into the directional hole at the rate of 350 bbl. an hour under a maximum pressure of 2200 lb. per sq. inch.

At the end of this period no change in the wild well was noticed and Texon officials decided to abandon for the time being attempts to kill it. In an effort to realize some measure of profit from what had been nothing but a huge loss, the relief well was plugged back and completed through perforations at 5810 ft. for a distillate well.

Since then the cratered well has burned thousands of barrels of oil unmolested and has become one of the show places of South Texas.

To review the early history of the well briefly, it blew out on November 19, 1936, from a total depth of 6638 feet. When the well first began "kicking" the blowout preventer rams were closed and an attempt was made to pump mud into the hole and kill the pressure; however, gas soon began showing around the outside of the 10-in. surface casing, set at 504 feet. In a very short time it had cratered and caught fire.

Losses from the blowout have amounted to thousands of dollars. In addition the cratered well has made the Agua Dulce area one of the most treacherous areas in South Texas in which to drill, as it has charged with high-pressure gas all sands from several hundred feet below the surface on down to 6800 feet. Several wells in the field have since threatened to blow out, causing much trouble and additional expense. Farmers in that area fear for their water supply, as artesian wells that previously had to be pumped are now flowing. Some have had to be plugged.

It is the current opinion of oil operators in the Corpus Christi section that if the wild well is ever brought under control nature, not man, will do the work.

After twelve months of derisive tactics, well still flows uncontrolled, besting man's efforts

fies Control « « « «

An aerial photo of the burning Texon Drilling Company's No. 2 Driscoll Sevier. The white area is mud and slush ejected by the cratering well and held back by 8-ft. dikes. In the center is the original well. Just to the left of it is a second crater, now dead, while in the upper part of the white area is a third crater that still is producing considerable gas. Just outside the dikes to the right of the burning crater is the relief well, drilled in an attempt to bring the No. 2 Sevier under control

Abstracts of A. P. I. Papers, 18th Annual Meeting . . . Chicago . . . November, 1937

R. J. SULLIVAN

Gas-Oil Ratio Control in Flowing Wells[1]

By R. J. SULLIVAN[2]

RECOGNITION of the function of natural-gas energy in the recovery of underground crude oil compels recognition of the need for gas conservation. Regardless of the manifold differences of opinion on reservoir classification, the facts persist that many so-called combination pools are produced in such a manner that compressed gas, associated in a free or dissolved state with the oil, becomes the chief propulsive agent, and that hydrostatic pressure and gravity are allowed to play only subordinate parts. Advancing knowledge of the behavior of sub-surface oil and gas has augmented emphasis upon the purpose and importance of producing oil with as low per-barrel volumes of gas as possible. During the past several years theoretical views as to the effect of gas conservation on economic exploitation and ultimate yield have gathered a background of convincing tangible results.

The foremost single factor in promoting realization of the benefits proceeding from proper utilization of gas energy has been proration. Obligatory curtailment of withdrawal has served as an unescapable object lesson highly suggestive of what should and can be done toward efficient production. As a rule, the competitive situation in a flush but restricted pool in the United States prevents any one operator from devoting more than casual attention to gas-oil ratio control. The growing popularity of coöperative or unitized development, together with modern policies of block leasing, tends to minimize difficulties of this sort. Proration has lately gone a step further toward attaining the object of true conservation by offering a definite incentive to the producer who is able to lift his allowable quota at favorable gas-oil ratios. Nearly all of the leading oil-producing states have sought to eliminate waste by introducing well spacing, sub-surface pressure, or gas-oil ratio elements into some of their regulations. Ordinarily, the measures aimed specifically at gas preservation stem from the concept of volumetric withdrawal as set forth by the Institute's Topical Committee on Allocation of Production. The troublesome "law of capture" is being weakened by modern proration. Examples of production allocation designed to penalize high gas-oil ratios are multiplying steadily. Because of special commitment to ultimate yield, several domestic pools, such as the pressure-maintenance projects throughout the country, expressly contemplate low gas-oil ratio production. Nor have the courts altogether refrained from placing pool welfare ahead of that of the individual, so that ultimate recovery might actually be held a prime objective. The industry is surely finding itself in a better position to employ advantageously the progress of intelligent investigation.

APPRECIATION OF CAUSES. The significance of sub-surface pressure, of reservoir-fluid properties, and of permeability in relation to formation arrangement, structural position, and depletion is commonly understood. It is sufficient to repeat that the typical pool giving rise to an acute gas-control problem is one in which the equalizing force of water-drive is either absent or rendered unavailable by withdrawal rate. Thus the plotted gas-oil ratio of a simple gas-drive pool traverses an upward trend toward a peak usually beyond the first pumping stage where slippage losses become extreme; thereafter a decrease in ratio sets in toward exhaustion of practically all gas. Depending upon the degree of curtailment and pressure support imposed, the curve shows an improved course through closer extremes. In the same respect, instances of what may be accomplished through proper utilization of natural forces heighten appreciation of the subject's allusions.

We are primarily concerned with the presence of expanding free gas at pressures and in volumes so large as to constitute a control problem removing any doubt of a well's ability to flow. It should be kept in mind that, if all other factors might be duplicated, a thick formation of high permeability can be expected to produce at lesser gas-oil ratios than one of comparatively thin section and low permeability.

WELL CHARACTERISTICS. As they are different fluids, oil and gas within a reservoir do not behave identically when impelled by a given differential pressure between the sand and a producing well. Hence, the proportion of gas delivery to oil delivery may be varied by alteration of the differential responsible for flow. So it is that by regulating the bottom-hole flowing pressure, as conveniently indicated by oil-production rate, the performance of a well with respect to gas-oil ratios may be determined. Most wells display characteristics either of decreasing ratios at lowered back pressures or of decreasing ratios involving an optimum intermediate production

(*Continued on Page 86*)

[1]Abstract of paper presented at eighteenth annual meeting, American Petroleum Institute, Chicago, November 12, 1937.

[2]The Carter Oil Company, Fairfax, Oklahoma.

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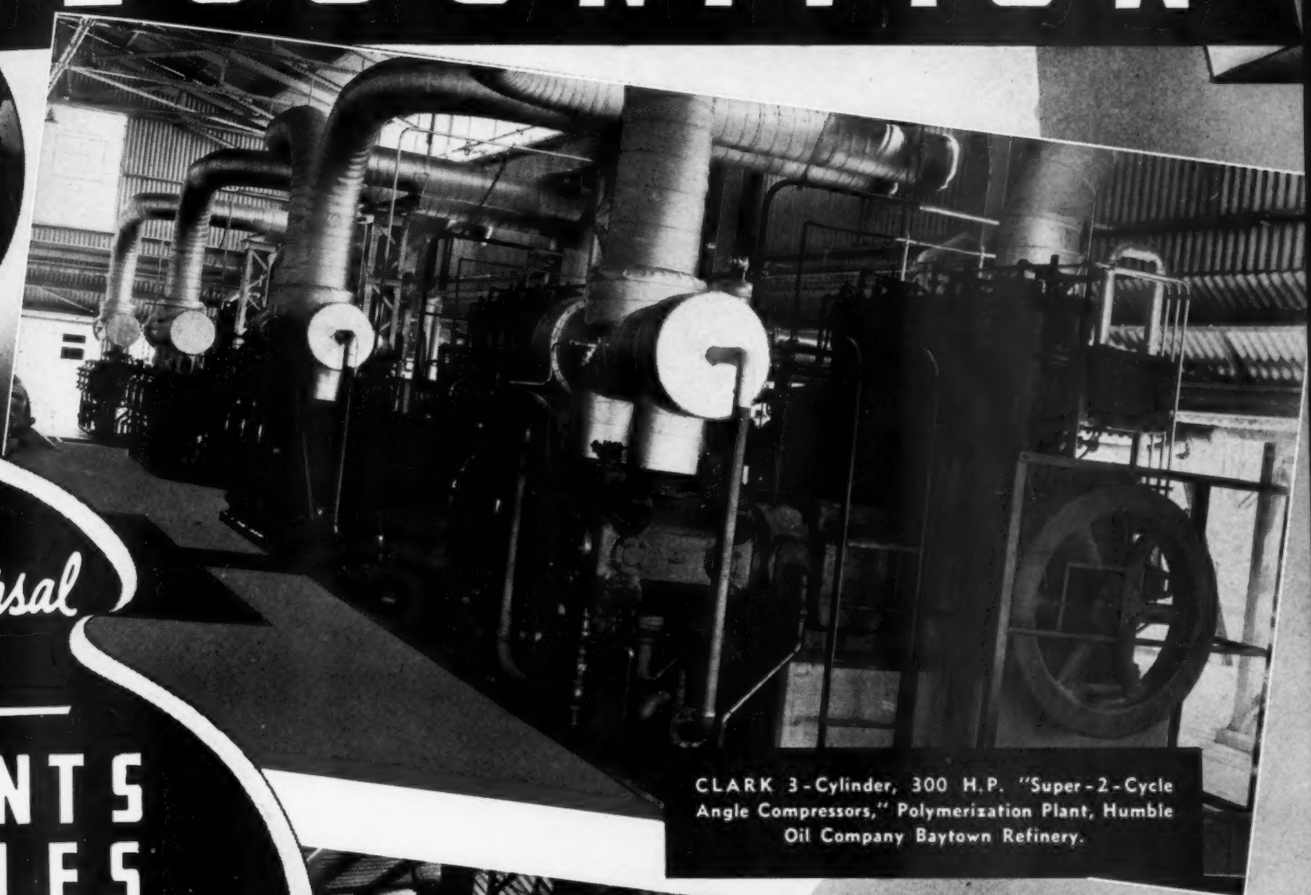
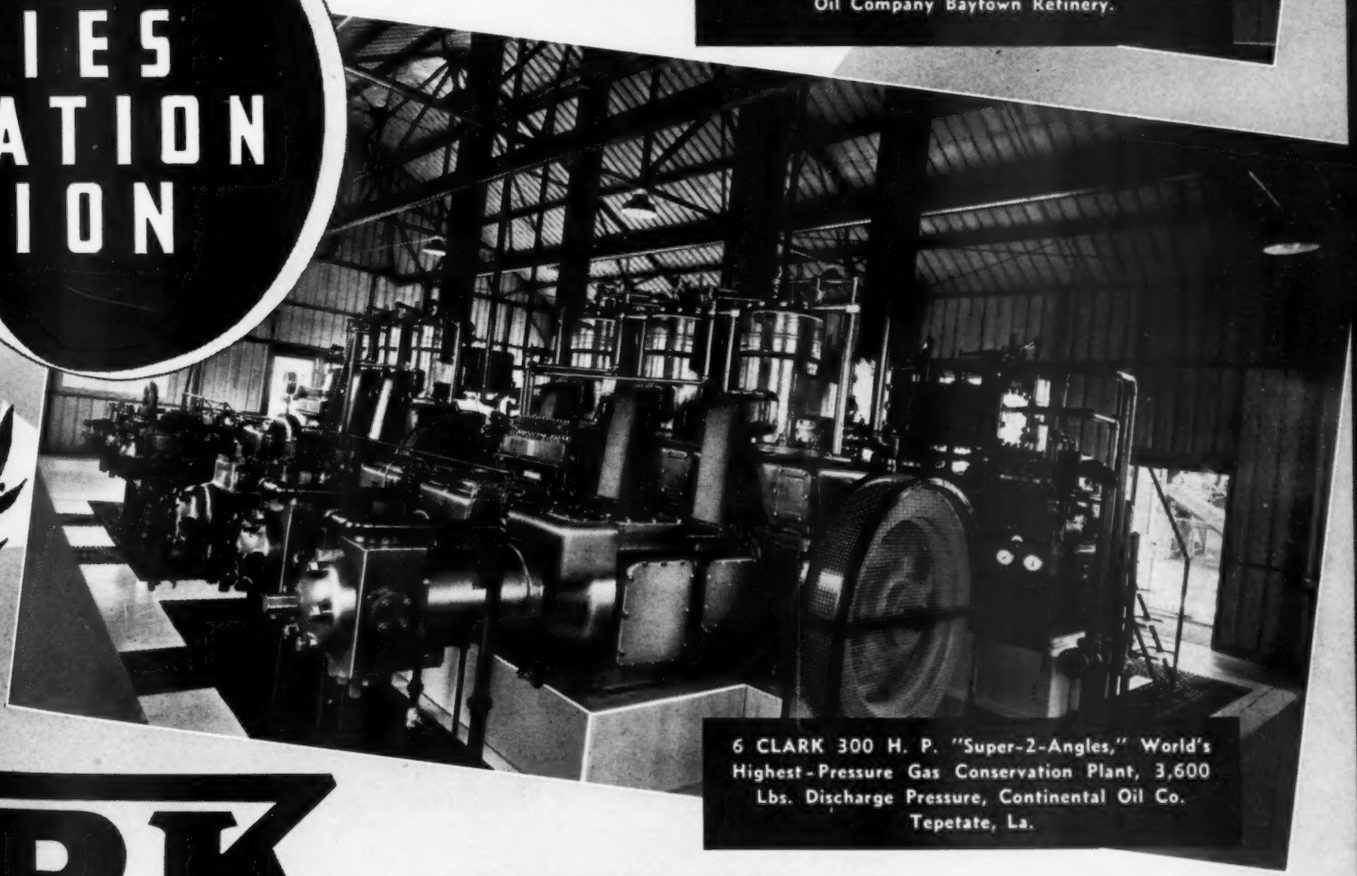


CLARK 3-Cylinder, 300 H.P. "Super-2-Cycle Angle Compressors," Polymerization Plant, Humble Oil Company Baytown Refinery.



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(*Continued from Page 82*)

rate beyond which ratios again incline higher. Provided tests are trustworthy and complete, many more wells may be placed in this second group at some time in their lives than is perhaps supposed. The fore part of characteristics of plotted curves of such wells is interpreted as due to gas velocities inadequate to move any but relatively small quantities of oil through either or both the formation and the eductor string to the surface. The reversal side of such curves may conceivably be attributable to excessive release of gas from solution in conjunction with approach of critical oil flow through the formation. The point stressed is that a characteristic can usually be established that will offer a rate of oil extraction distinguished by a minimum gas-oil ratio. Supplementing bottom-hole differential data and reservoir-fluid analysis, factor curves are very valuable in regulating producing rates between wells so as to strive for maximum reservoir efficiency. No pretense is made that the minimum ratio flow of individual wells is the standard for gauging pool optimum.

A single characteristic may not prevail throughout the life of a well, particularly if it is exposed to cap migration. Gas-factor-production-rate histories from wells in certain sectors suggest a disposition of characteristics to move upward and outward from the origin; i.e., the optimum rate and minimum obtainable ratio increase with passage of time. It appears that, as depletion progresses and reservoir pressure declines, the locus of the gas-oil ratio curve in relation to a prescribed set of coördinates is continuously positive for both x and y values. The scope of this method of control in the latter periods becomes narrower, more difficult to stabilize. Elevation of the minimum ratio per well is known to be reflective of a pool's over-all tendency to produce at consistently higher factors.

In view of the diverse flow peculiarities of oil and gas, a gas-oil-ratio reading is almost meaningless unless accompanied by reference to appropriate production rate. Care should be exercised in evaluating results of other control methods to ascertain whether, if treatment does not include actual alteration of production rate, there is not some adjustment of differential on the oil-bearing sand, the gas-bearing sand, or both.

WORKING FLUID LEVELS. The explanation for effectiveness of producing through tubing set deeply as compared with tubing set near the top of the pay formation lies in precisely this latter point. Through fluid-level control, the pressure differential on one portion of the formation relative to that on another portion may be regulated so as to bring about reductions in gas-oil ratio. It is sometimes possible to combine regulation with a fluid-head sealing effect above the tubing entry so that free gas is confined to the casing. Generally the fluid-seal method is at best a temporary, unstable expedient in accordance with the permeability and sand thickness present and with the degree of free-gas encroachment. In marginal cases, very watchful manipulation of tubinghead and casinghead pressures is required.

Betterment of gas-oil ratio by application of gas-lift, aside from its familiar application to wells which have come to a heading phase of deficient gas or pressure, falls into this same category of fluid-level control in turn referable to differential-pressure adjustment.

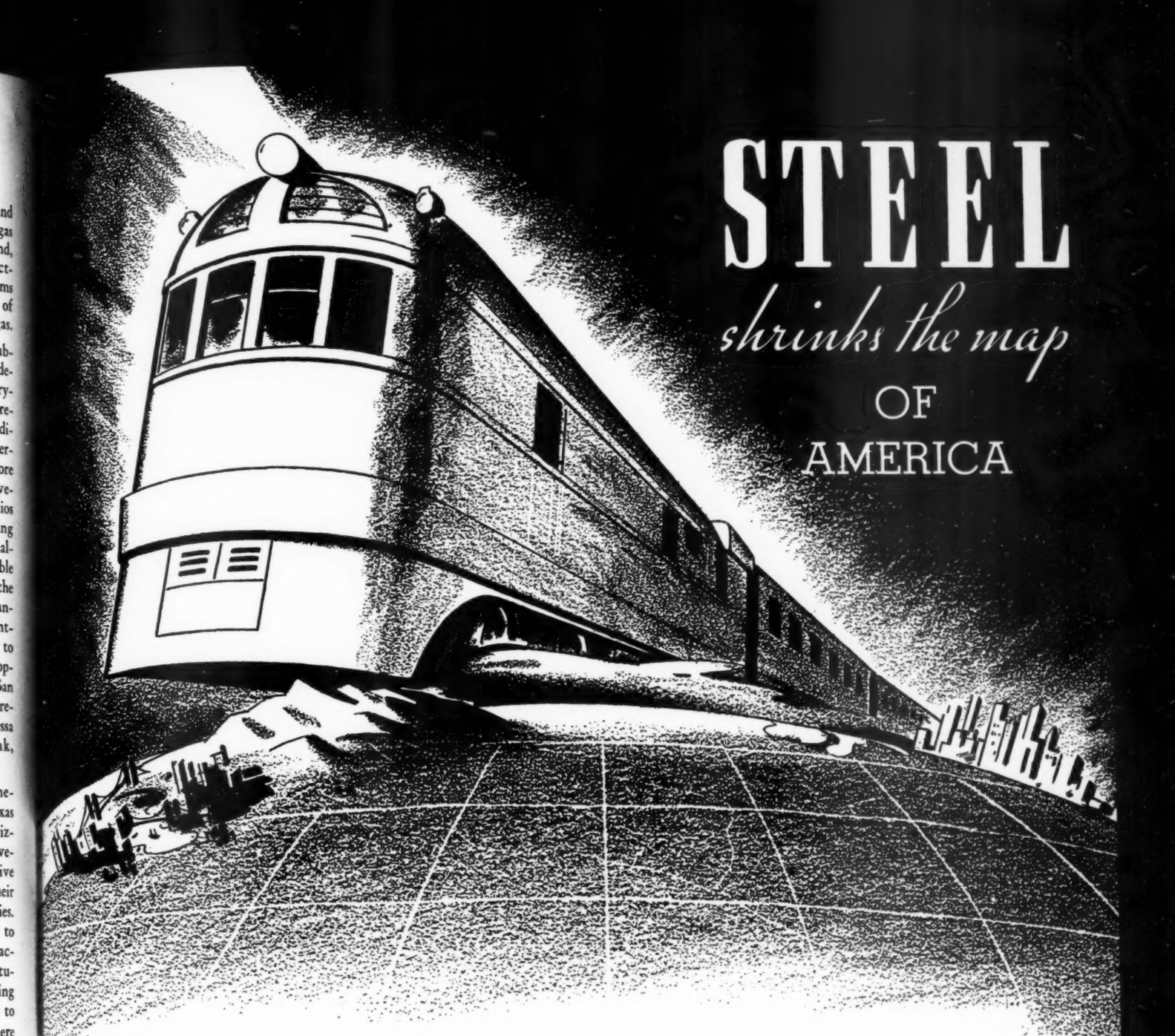
FLOW-STRING DESIGN AND SUB-SURFACE CHOKES. Claims for the efficiency of tapered tubing and bottom-hole choking are not always properly qualified. Inasmuch as given conditions of pressure differential across a sand face release definite volumes of oil and gas, any notable improvement in the formation gas-oil ratio cannot legitimately be ascribed to either of these contrivances. Some discredit has been thrown upon the soundness of the theory behind tapered tubing. It has logically been held that slippage and friction tend to compensate each other to an extent that the net effect is almost negligible as against that of other considerations. Much more can be accomplished by treating slippage in the formation itself. Avoiding the controversial matter of the type of gas expansion that takes place in a vertical pipe, it is certain that at high pressures rather small volumes of gas are sufficient for lift. But, palpably, if the formation ratio cannot be reduced below a figure far greater than the work requirement, nothing is to be gained from elaborating upon flow equipment. There is no denying that gas unnecessary to the work of lift is a hindrance to efficient tubing flow. Still, since gas delivered to the well bore must normally emerge at the surface, the question inevitably comes down to prevention of gas escape from the formation.

Even in theory, bottom-hole choking aims solely to utilize to better advantage the expansive force of gas by localizing back pressure at the sand face. As to actually combating free gas originating from the producing sand, bottom-hole choking cannot be expected to reduce gas-oil ratios. Few claims are any longer heard for the efficacy of small tubing in overcoming free gas.

INTERMITTENT FLOW. Laboratory experiments with partly-depleted sands susceptible to secondary-recovery operations have been correlated with field observations to indicate that capillary movements of reservoir fluid so as to bring about a more uniform saturation lead to improvement of gas factors. Undesirable ratios are sometimes remedied in repressuring practice by a shut-down or differential-pressure adjustment. With favorable depletion status and permeabilities, the same practice is of assistance in handling flush production. Intermittent-flow methods have been resorted to throughout the past two years in coping with a free-gas problem at San Pedro, Argentina. It has also been reported as of some help at Rodessa (Louisiana-Texas), South Burbank, and Keokuk.

ACID TREATMENT. In lime-producing areas, such as West Texas and New Mexico, evolution of acidizing technique has encouraged improvement not only of the oil-productive capacity of wells, but also of their relative oil and gas productivities. Essentially, acidizing is tantamount to a permeability increase. When its action can be restricted to an oil-saturated section, meanwhile protecting the gas zone, the result is analogous to differential-pressure adjustment. There are a number of variations in the procedure of introducing acid and auxiliary fluids into a well with the intent of improving its gas-oil ratio. Wells whose ratios, remedied by an initial treatment, tend in time to rise are later re-treated with a proportionately larger stage of acid.

POSITIVE EXCLUSION OF GAS. After a well has been so exposed to free-gas migration that its characteristic climbs to an excessive height attended by the production of very large gas volumes, it is felt that the only remaining method of curtailing gas escape from the formation is a positive shut-off. Just as any other successful control method, viewed in its essentials, this quite plainly amounts to alteration of the differential pressures among oil-bearing section, gas horizon, and well. The utter absence or undependability of any true barrier stratum separating upper gas from underlying



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oil forces reliance of a mechanical shut-off upon an effective difference between transverse and bedding plane permeabilities. Many sedimentary deposits possess this quality.

Packers. It is very simple, but probably undesirable, to set formation packers arbitrarily low in the pay sand and thus obtain a greatly-reduced gas-oil ratio at the risk of isolating oil that might later be difficult to recover. Consequently, formation-packer installations are made as close as practicable to the gas-oil contact. Given a sound mechanical seal, prime factors then entering into the well's performance are gas-coning and drainage through the hole's area of reservoir influence. It has been learned thus far that the more prolific wells require more frequent shut-downs, but likewise that they share a tendency to reach individual maxima evidently consonant with the current stage of reservoir depletion and gas-cap expansion. Not only the averages, but also the criticals or peaks, have been retarded to values far preferable to open-hole factors. No such complications enter, of course, if an extensive barrier stratum can be found and used as a shut-off point.

Cementing. Due to its reliance upon a strong peripheral bond, the cementing of pipe against gas sands may fail to obtain a shut-off if an ample amount of cement has not impregnated the walls of the formation at pressures overcoming the pressure of gas itself. Cementing owes much of its merit to development of the squeeze method and of cement design in recent years.

Preventive steps adopted in well completion, as in some of the deep, thin sands of the Gulf Coast area, necessarily entail special use of cement. It is customary in modern high-pressure wells to set and cement the oil string through any upper gas sands. Here, too, the practice finding recent favor is that of cementing the oil string from the base of the pay section upward with the purpose of selective completion and progressive control of encroaching gas and water.

Circumstantial advantages and disadvantages, ranging from physical adaptability to over-all economy, hazards, and like considerations, are attached to both cement and packer installations, each claiming its own adherents. Any positive shut-off procedure has as its first demand a sound mechanical seal that is proof against channeling in the hole itself.

CONCLUSIONS. Mindful of the basic causes of high gas-oil ratios, and particularly of the importance of reservoir thickness, permeability, and fluid properties, these conclusions have been drawn:

1. Most flowing wells presenting a gas-control problem respond to proper testing by yielding a variety of gas-oil ratios as the rate of production is varied.

2. Selection of the most desirable production rate should be guided by a standard of pool efficiency over protracted periods. Well characteristics change with depletion and sub-surface pressure decline.

3. Production-rate regulation is actually a misnomer for differential-flow pressure adjustment, to an aspect of which all control methods must be reduced. The comparatively new and limited method of preferential acid treatment is included.

4. The gas-oil ratio control question is primarily one of preventing withdrawal of free gas from the pay formation. With high-pressure and large-volume gas conditions, special flow-string equipment of itself hardly can be expected to improve gas-oil ratios.

5. When the desirable utility of other differential regulation methods has been exhausted, the next resort in controlling ratios is to shut off gaseous formations mechanically at the sand face. Where this measure does not eliminate coning action, stopcocking may prove helpful.

6. Continued gas-cap expansion normally influences the permanency of any successful control method, either remedial or preventive. They should, accordingly, be undertaken with an appreciation of future contingencies.

S. H. McALLISTER

The Catalytic Polymerization of Butylenes by Sulphuric Acid[1]

By S. H. McALLISTER[2]

CONTINUED improvements in automobile and airplane engines have called for "tailored fuels" of very high anti-knock rating. The major source for such fuels lies in the polymerization of the lower olefins, and today there are a number of different types of commercial polymerization units in operation. The potential production of polymer gasoline has been estimated as over a billion gallons per year; and the advantages, both from

(Continued on Page 91)

[1]Abstract of paper presented at eighteenth annual meeting, American Petroleum Institute, Chicago, November 12, 1937.

[2]Shell Development Co., Emeryville, Calif.

(Continued from Page 88)

an economic and conservational standpoint, have already been pointed out by Dunstan, Egloff, and Ipatieff, and others.

This discussion is confined to processes for the production of an octane fuel having an octane rating of 98 to 100 from the C_4 fraction obtained from the Dubbs process. The Shell Companies have been producing *iso*-octane in commercial quantities by two methods that have been developed by them. The feed stocks used vary at different refineries, but a C_4 fraction containing 18.5 percent *iso*butylene and 28 percent normal butylenes might be chosen as representative of that available at a California refinery. The first commercial process used in the spring of 1934 was a cold-acid process.

COLD SULPHURIC-ACID PROCESS. The processing unit (Fig 1) consists of two sections: an absorption section and a polymerization section. The liquid hydrocarbon is contacted with 60 to 70 percent sulphuric acid at 20 to 35 deg. cent. countercurrently in two stages. Under these conditions the *iso*butylene, which is the more re-active of the olefins, is selectively absorbed into the acid phase. The absorption is an equilibrium reaction, and the amount of *iso*butylene absorbed depends upon:

1. *Acid strength:* The stronger the acid, the more complete is the absorption of the *iso*butylene below limits where polymerization occurs. However, if the absorption is to be selective for *iso*butylene, acids of less than 70 percent strength should be used or the normal butylenes will also be absorbed.

2. *Acid-to-alcohol ratio in the acid phase:* The higher this ratio, the more complete the absorption.

3. *Temperature:* The lower the temperature, the more complete the reaction. However, temperatures above 20 and below 40 deg. cent. are preferable if a high reaction rate is to be obtained without premature polymerization.

Under the proper operating conditions it is possible to absorb up to 90 percent of the *iso*butylene without appreciably absorbing the normal butylenes.

The acid phase, after it has reached the desired degree of saturation with *iso*butylene, is separated from the hydrocarbon phase and passed through a separate polymerization unit consisting of coils heated to 100 deg. centigrade. The reaction is complete in about a minute, and the products are stratified

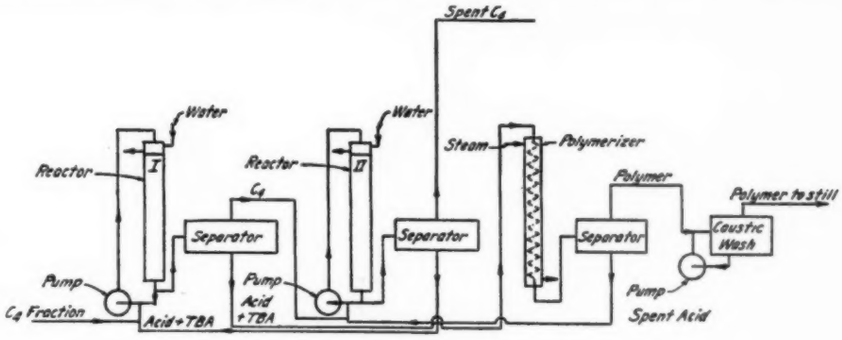

Fig. 1. Cold-Acid Iso-octane Plant

—the acid being returned to the absorption unit, while the polymer is washed and distilled. With 65 percent acid the polymer averages 75 percent di-*iso*butylene, the rest being trimers. With weaker acids a higher dimer content is obtained. After mild hydrogenation of the di*iso*butylene cut, *iso*-octane (2,2,4-trimethyl pentane) is obtained.

This cold-acid two-stage process has been in use for some time, and is still the most suitable method of preparing pure *iso*octane. However, on the basis of the total olefins present in the C_4 fraction, the yield of octanes is relatively low; not more than 67 percent of the *iso*butylene is converted to *iso*-octane; i.e., less than 26.7 percent of the total olefins in a feed stock containing 45.5 percent olefins. Increasing demands for polymer of 98 to 100 octane number has led to the development of the present hot-acid process, in which almost twice the yield of octane may be obtained from the same feed stock.

HOT-ACID POLYMERIZATION. The hot-acid polymerization process was a direct outgrowth of the former process. When the temperature of the acid absorption reaction is raised, the absorbed *iso*butylene present in the acid phase condenses to polymer, and this is re-absorbed into the hydrocarbon phase. At temperatures above 60 deg. cent. this polymerization is sufficiently rapid that the absorbed *iso*butylene has only a transitory life in the acid phase, and the process becomes truly catalytic. The net effect of this is to force the absorption reaction to completion by maintaining the acid phase in a spent state. Thus it is possible to recover all of the *iso*butylene as polymer.

Raising the temperature also has the effect of reacting a portion of the normal butylenes, and these are absorbed into the acid layer principally in the form of acid sulphates. Although the normal butylenes do not polymerize with themselves as readily as does *iso*-butylene, in the presence of *iso*butylene they will react rather rapidly to form interpolymer. Thus, under proper operating conditions, it is possible to react up to an equal quantity of normal butylenes and *iso*butylene and, as the interpolymer on hydrogenation has an octane number nearly equal to that of pure *iso*octane, nearly double the yield of polymer is obtained without seriously sacrificing octane rating.

Besides the favorable effect on the olefin absorption, hot-acid operation has a further advantage in that polymer as formed passes into the hydrocarbon phase, and is diluted by the inert butanes; its activity is thereby reduced, and there is less opportunity for trimer formation or re-arrangement to polymers of lower octane number. The result is that the polymer is 85 to 90 percent octanes as against 75 to 80 percent for the old or cold-absorption process.

LABORATORY INVESTIGATIONS. The results obtained by the process are dependent upon the mechanical system used, as well as upon chemical factors, such as acid strength and temperature.

A number of experimental reaction systems has been studied. These consisted of packed towers, heated coils through which the reactants were rapidly passed, a reactor employing jet injection of the hydrocarbon into towers containing acid and a single mixer-type reactor. This latter arrangement proved to give the best results.

In this system the incoming feed is diluted with a much greater volume of the acid-hydrocarbon emulsion which contains practically no unreacted *iso*butylene. Thus the ratio of

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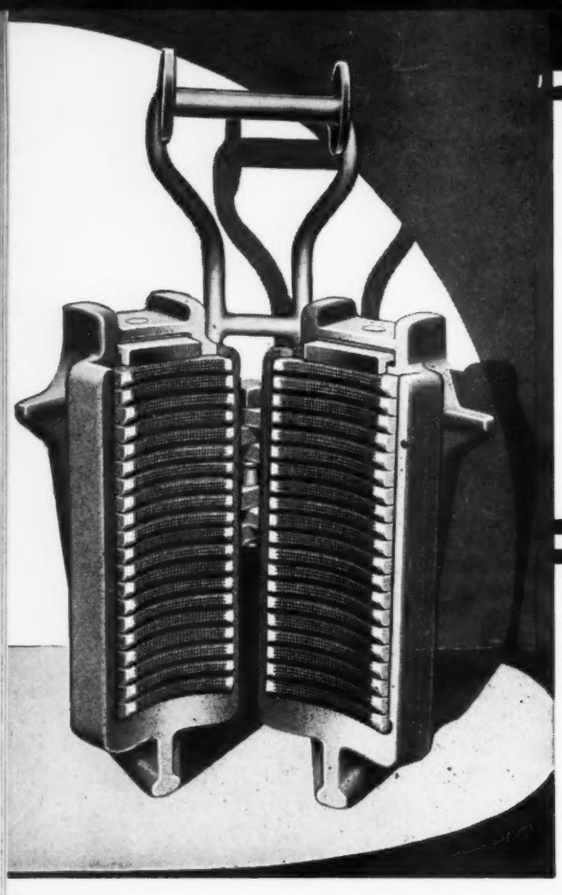

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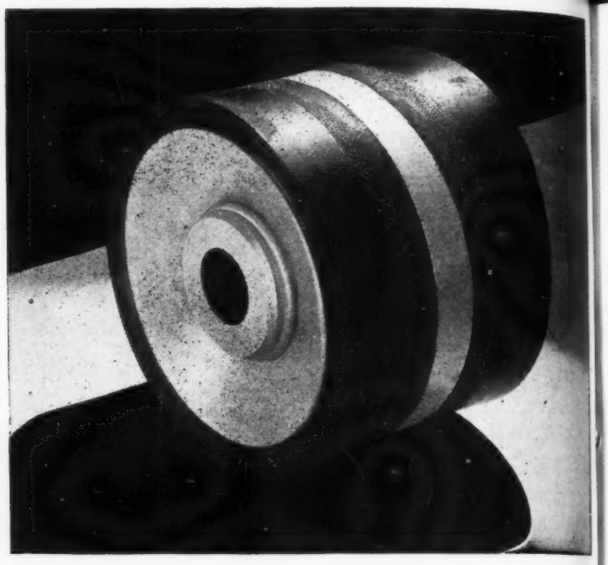

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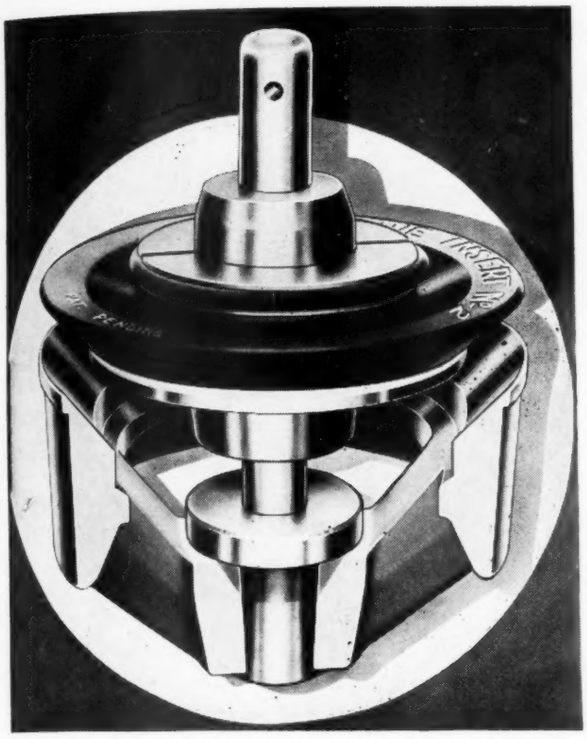

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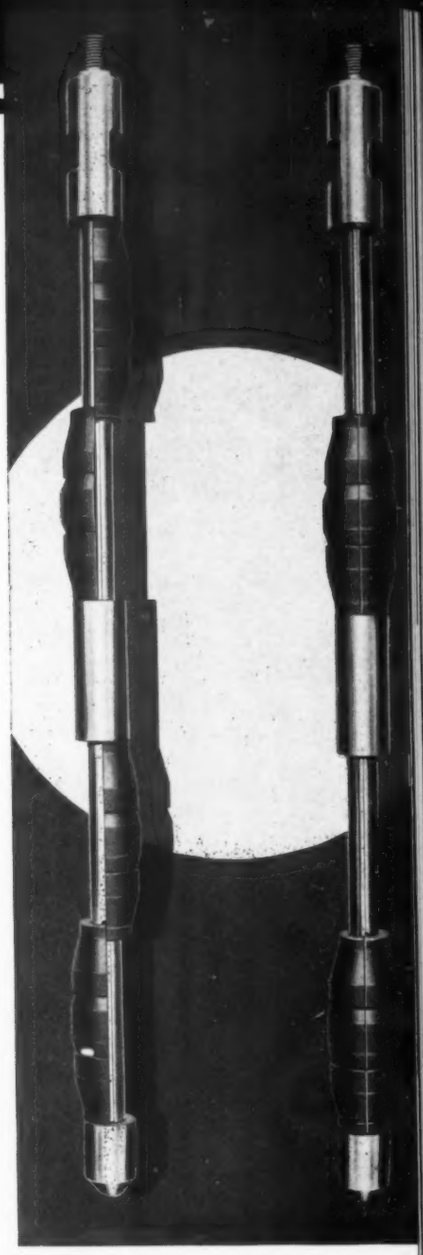

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(Continued from Page 91)

*iso*butylene to normal butylenes is very low, and interpolymerization is greatly favored; whereas in the coil or tower reactors co-polymerization of the *iso*-butylene is favored owing to its higher initial concentration and much greater reaction rate.

Using the mixer type of reactor, the effect of the several variables in the reaction was experimentally determined. It was found that:

1. The effects of temperature and acid strength are closely interrelated. Acids ranging from 63 to 72 percent by weight can be used at temperatures from 75 to 100 deg. cent., the higher acid strength being used with the lower temperatures. It is preferable not to use stronger acids or higher temperatures, as formation of sulphur dioxide or sulphate ester will then become appreciable. Lower acid strengths lead to longer contact times and enhanced corrosion of the reactor system. However, within the above range, considerable flexibility is allowed without appreciably altering the results that are obtained.

2. The size of the acid phase also affects the reaction. The larger the acid phase, the more rapid is the reaction. However, for commercial operation in the above limitations of acid and temperature, there seems to be little advantage in using more than a 1:1 or 2:1 ratio of acid to hydrocarbon.

3. The effect of increasing contact time is to increase the amount of reaction until an equal quantity of *iso*-butylene and normal butylene is reacted. Above this, large increases in contact time increase the yields only slightly.

By using combinations of these variables, it is possible to react 90 percent of the *iso*butylene and 10 percent of the normal butylene, or completely to react the *iso*butylene and an equal quantity of normal butylenes. This flexibility is an advantage when volatility requirements in winter call for more butanes and butylenes.

COMPOSITION OF THE ACID PHASE. The sulphuric acid used in the process functions as a catalyst, and contains relatively small amounts of organic materials. It is used for weeks or months without change, fresh acid being added from time to time merely to make up for that lost by mechanical entrainment. The chemical consumption cost is, therefore, very low.

LARGE-SCALE APPLICATIONS. The laboratory results were directly translated to full commercial-scale plants with the predicted yields. The Martinez polymer plant is shown in Fig. 2. The reactor unit resembles a single stage of the cold-acid process. In fact, the equipment is largely interchangeable. In the plant the fresh feed meets re-cycling emulsion, and the mixture is then rapidly re-cycled through a heat exchanger and time tanks. A portion of the emulsion is continuously withdrawn to a separator, where the acid is separated and returned to the reactor, while the hydrocarbon is worked up for the polymer.

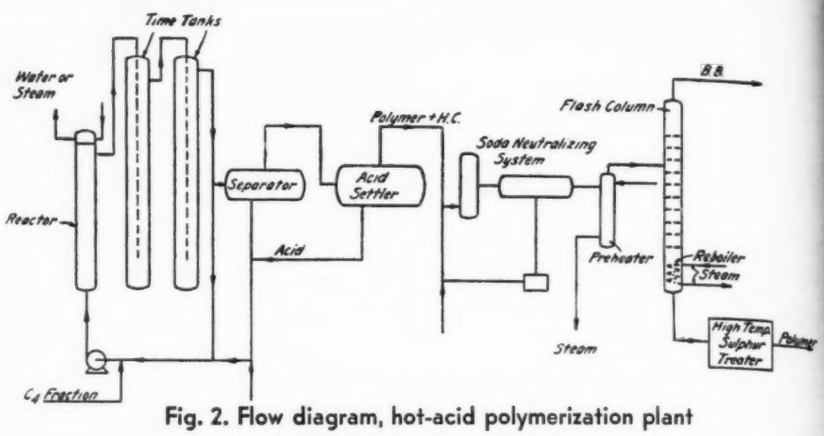

Fig. 2. Flow diagram, hot-acid polymerization plant

The operation of the unit is extremely simple—one operator per shift being sufficient. No external heat is required, as the exothermic heat of reaction is sufficient to maintain the temperature in the reactor. The return of the acid to the reactor is largely automatic, once the rate of flow is established. In present practice 67 percent acid is used at approximately 80 deg. cent., and a 10- to 15-min. average contact time is allowed.

POLYMER RECOVERY SYSTEM. As has already been pointed out, the polymer in the hot-acid system is recovered from the hydrocarbon layer. This recovery consists of a caustic wash to remove entrained acids or acid sulphates, a flash tower to strip off the spent hydrocarbon gases, and a high-temperature treater for further sulphur removal. This latter unit serves the valuable purpose of removing the stable sulphate esters that are present in the polymer to the extent of 0.2 to 0.4 percent calculated, ASTM sulphur. After treatment less than 0.03 percent sulphur remains, and sulphate-ester removal is substantially complete. The polymer is thus rendered stable to distillation, or it could be added directly to gasoline without impairing its color or stability.

The octene fraction is refractionated and hydrogenated under mild conditions. The product obtained averages 98 to 99 octane number. Thus, as already pointed out, by hot-acid operation the yield has been doubled without sacrifice of octane number.

CORROSION. One question of importance in commercial applications is that of corrosion through the use of sulphuric acid at these temperatures. No special allows are used in any of the plants. The reactors themselves are of mild steel, and the pumps are of standard design. Iron or steel tubing is used throughout. Copper and bronze could also be used, but stainless steel shows very poor service. In one refinery reactors that previously had seen considerable service under the conditions of the cold-acid process have been in continuous use on the hot-acid process for 18 months, and are still giving good service. With proper design and reasonable care, maintenance costs are very low. Evidence indicates that wear results as much from erosion as from corrosion, and in any case these are not serious factors when considering a plant of this type. The major cost in a polymer plant is in the distilling and auxiliary equipment, which is common to any catalytic process. The reactor unit itself is relatively inexpensive.

PATENTS. Various features of these processes are covered by patents and pending applications in the United States and abroad.

CONCLUSION. From the foregoing it is apparent that the hot sulphuric-acid process as operated by the Shell Companies is particularly applicable to the polymerization of the C_4 fraction when octanes of 98 to 100 octane number are desired.

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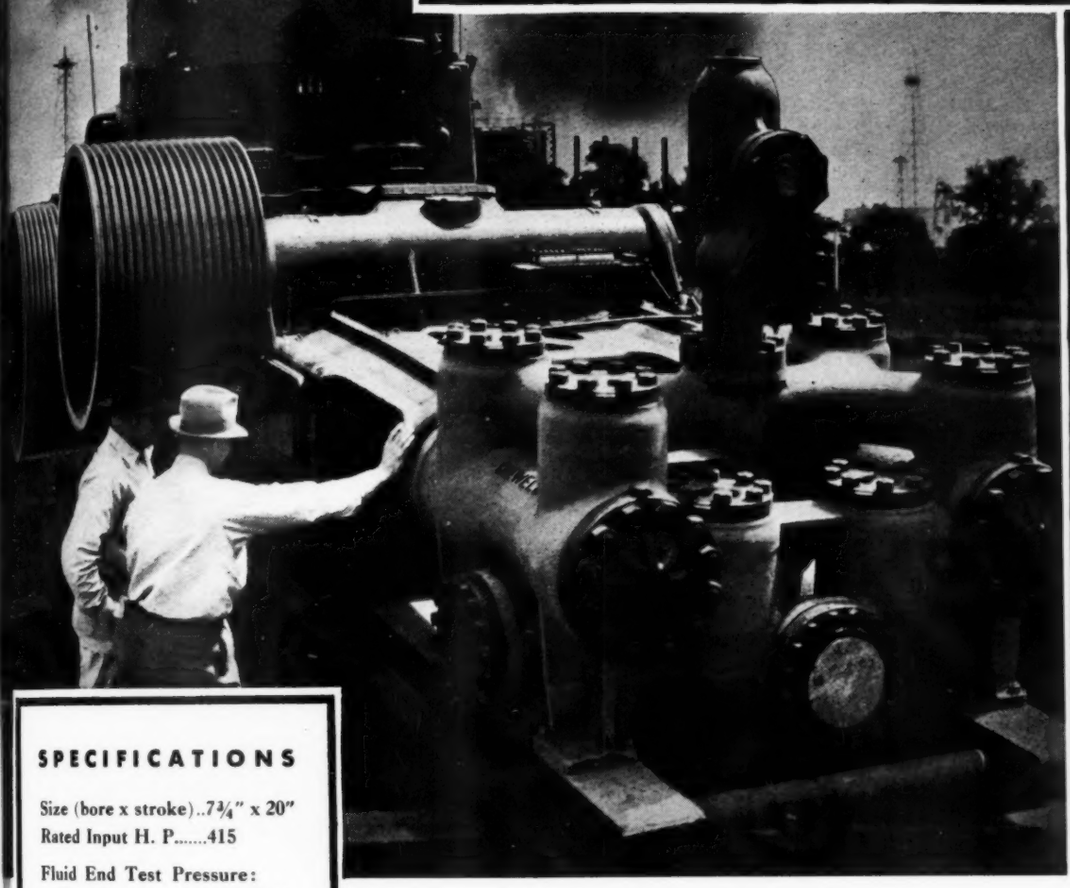

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Selection of Screen Openings for Unconsolidated Sands[1]

By C. J. COBERLY[2]

C. J. COBERLY

THE proper functioning of screen casing is important to the production of oil, as it materially affects the pressure gradient in the immediate vicinity of the well, and it controls the production of sand with the oil. There has been some research and considerable speculation about the shape, size, position, and arrangement of openings in screen and perforated casing; yet little published data on which to base their selection have been available.

OUTLINE OF WORK. The object of the work was to establish an exact analysis of the bridging problem, to correlate such data as were available with this analysis, and to perform additional experiments to extend the range of variables of existing data.

It was realized early in the investigation of the properties of screen casing that sands, because of the variation in grain shape, were not suitable for an exact investigation of the bridging of openings, even though they were carefully classified as to grain diameter. Spheres were chosen as the "sand grains" of an ideal system, the behavior of which could be determined and duplicated with an exactness that was impossible with sand grains.

APPARATUS. The apparatus devised to investigate the properties of slotted openings was arranged so that the width of openings could be regulated by means of a micrometer screw, and so that the shape of the opening could be altered by inserting different sets of hardened and lapped steel blocks in the base.

For the work on round holes, a 16-leaf iris diaphragm was chosen because of its ready adjustment to different diameters. The approximation to a circular opening was good in the range investigated (0.06 in. to 0.6 in. diameter).

The apparatus used in conducting experiments on the effect of slot position and arrangement, and on the effect of pressure on bridge formation and stability consists of a square container 3¾-in. inside size, with a 2½-in. round opening in the side and bottom over which plates having various slot openings and arrangements could be bolted. The removable cover was arranged for an oil filler hole, and for connection to a source of constant pressure.

Steel balls were used as the spheres for the ideal system, because they were available in quantity in the proper range for sizes, and with the accuracy and hardness surface finish desired.

DEFINITIONS. To facilitate the study of bridging, the following definitions are proposed:

A stable bridge is one that, when disturbed, will reform almost instantly.

The stable opening is the size of opening on which a stable bridge will form. It may be expressed as a dimension or in terms of the size of the bridging medium.

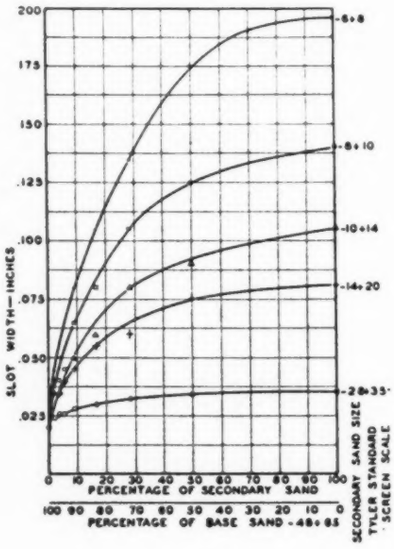
The maximum opening is the size of opening on which a bridge will not form even by blocking the opening from below to permit it to fill with grains under static conditions, and then carefully removing the obstruction. It may be expressed as a dimension or in terms of the size of the bridging medium.

The range of bridging is the ratio of the maximum opening to the stable opening.

The bridging grain size is the diameter of a sphere that would form a bridge on a given slot with a stability equivalent to that formed by a given material on the same slot.

In this paper, whenever grain diameter is referred to, it is taken as equal to the opening in the retaining Tyler screen.

Fig. 1. Slot-bridging test—beach sand



RESULTS OF STEEL-BALL TESTS. The first investigations were made on the bridging of 1/16-in., 3/32-in., and ⅛-in. steel balls on slots of rectangular opening and cross-section.

The slot width for stable bridging was found to be two times the diameter of the balls. The upper limit of bridging was found to be at 2½ times the ball diameter. The range of bridging is thus seen to be 1.25.

A few experiments using mixtures of two different ball sizes were made. The effect of the large balls in increasing the slot width at which bridging occurs is considerable as compared to the percentage in the mixture. This is an important factor, as will be brought out later in the discussion on the bridging of formation sands.

It was found that a stable bridge was formed on round holes having a diameter up to three times the diameter

[1]Abstract of paper presented at eighteenth annual meeting, American Petroleum Institute, Chicago, November 12, 1937.

[2]Kobe, Inc., Huntington Park, Calif.

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of the balls. The maximum hole was found to have 3¼ times the diameter of the balls. The range of bridging is 1.08, which is considerably less than for rectangular slots. (The apparatus may have influenced the results on the maximum hole somewhat, as it was found in the case of the 3/32-in. balls that the upper limit of bridging was on a hole having a diameter of approximately 3.5 times the ball diameter).

Throughout the tests on slots and round holes it was noticed that, when the slot or hole was larger than that for stable bridging, the action of the balls in rolling into the wedge-shaped valley formed by the withdrawal of balls as they fell through the slot was enough of a disturbance in many cases to cause the balls to flow continuously through the slot. To obtain a representative test, it was necessary to keep the balls remaining in the tester carefully leveled off. This instability due to disturbances behind the slot will be commented on later in connection with grouped slots.

RESULTS WITH CLASSIFIED SAND GRAINS. The work done on steel balls was repeated using classified sand grains in the same testing apparratus. The sand used was a beach sand composed of angular grains with well-rounded edges. A stable bridge is formed on a slot having a width of approximately twice the grain diameter. The maximum slot was found to have a width of approximately three times the grain diameter. The range of bridging is then 1.5. This is a considerably wider range of bridging than was found when using steel balls. The increase is probably due to the effect of the shape and angularity of the grains.

Slot-bridging tests were also made on binary mixtures of various grains, and the results are shown in Fig. 1. As with the steel balls, the effect of a small percentage of grains of secondary sand in increasing the width of slot on which a stable bridge is formed is quite marked. The effect is more pronounced the greater the ratio of diameters between the primary and secondary sands.

The bridging of sand grains on circular holes was investigated, using the same iris as was used for the tests on the bridging of steel balls on round holes. It was found that a stable bridge was formed on circular holes having a diameter of three times the grain diameter, and that the upper limit of bridging was on holes having a diameter as great as 4.5 times the grain diameter. The range of bridging is then 1.5, the same range as was obtained for sand grains on rectangular openings. The increase in the range of bridging over similar tests with steel balls can again be attributed to the angularity and shape of the sand grains.

This brings out the fact that the range of bridging will be a function of the particular sand used. It will not be 1.5 for all sands, but will vary with the shape and angularity of the particular sand under investigation.

FORMATION SANDS. The sands from which oil is produced are complex mixtures of grains. The bridging action of such sands reduced to ultimate particles depends on the grain size, distribution, shape, and angularity. The effect of the latter two items is generally neglected. The effect of the former two can be obtained from the screen-analysis curve.

BRIDGING WITH FORMATION SANDS. The uniformity of distribution throughout the entire grain-size range probably has some influence on the bridging characteristics of a particular sand. However, the controlling factor is generally to be found in the gradation of the coarse grains in the lower end of the curve. Examination of hundreds of samples in the adjustable slot apparatus, and comparison with their screen analysis, has established the fact that in general the bridging grain size is the grain size at the 10 percentile of the cumulative screen analysis.

EFFECT OF POSITION, SHAPE, AND ARRANGEMENT. The effect of the position and arrangement of openings on the stability of bridging were determined. It has been shown by proper selection of the slot width and thickness in relation to the angle of repose of the sand to be placed behind the slot that a horizontal slot in a vertical plate will hold sand that the same mesh vertical slot in a vertical plate will not hold.

To illustrate the fallacy of this theory under flow conditions, a slot of such a width that dry sand would flow through when the slot was placed vertically, but was held when the slot was placed horizontally, was chosen. A 2-in. sixty-thousandths slot and — 28 + 35 sand were used (ratio of grain to slot 3.7) with crystal oil as the fluid. The sand was placed 2⅜ in. above the center line of slot in both cases. The oil surface was maintained 2⅜ in. above the sand, making a total head of oil of 5 inches. In the case of the horizontal slot, the resulting flow was 77.5 cc. per minute, of which 36.5 cc. was sand. In the case of the vertical slot, the total flow was 93 cc. per min., of which 46 cc. was sand. Sand flowed through either slot with only 1/32 in. of oil above the sand.

The following conclusions are drawn from this test:

1. Slots exceeding the maximum opening for a given sand permit the flow of sand as long as oil is flowing, the slot being in either a horizontal or vertical position.

2. Vertical slots of the proper width for the sand are equally as effective as horizontal slots in holding back sand.

Slot width alone controls the bridging effect, the position of the slot being immaterial.

In conducting the slot-bridging tests it was found that there was a tendency to bridge in the slot itself. It was first thought that this was due to the slots having a slight amount of negative undercut. However, investigation showed that the slots were parallel, or in some cases slightly undercut. Further experiments showed that the greatest tendency for the slots to fill up occurred when the slot width was from 0.0015 in. to 0.002 in. less than two times the ball diameter, when using balls of one size, or from 0.0015 in. to 0.002 in. less than the sum of the ball diameters when using mixtures of two ball sizes. With undercuts greater than this, it was not possible to make the slot fill with steel balls.

With sand grains, slots having undercuts of 0.0012 in. filled up readily. Sand was found to lodge in slots having undercuts up to 2 degrees. In a great number of trials no bridge was formed in slots having an undercut of 6 degrees.

A series of tests was run to determine the effect of the arrangement of openings on bridging.

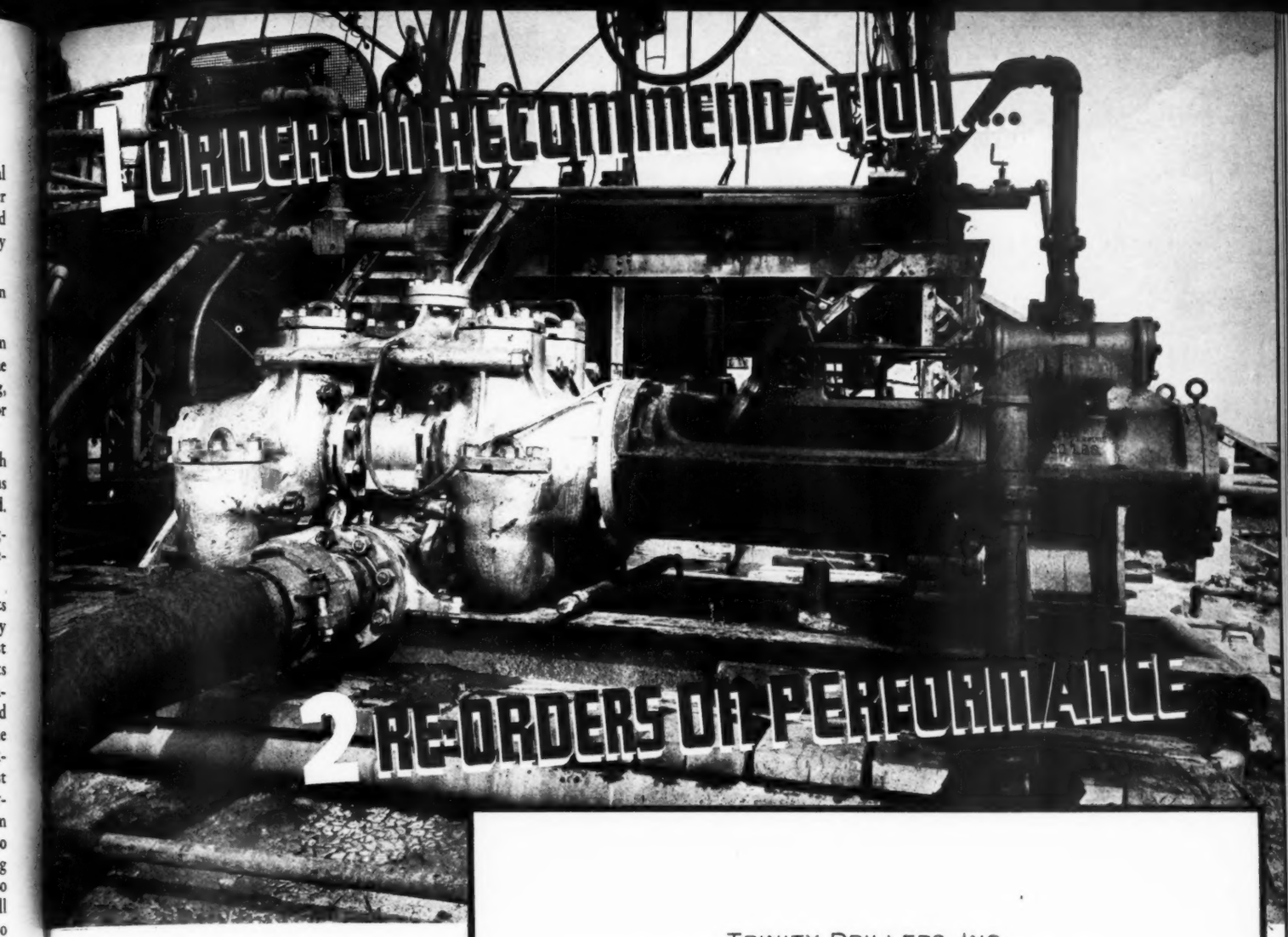
The procedure was to bolt the desired plate in place over the opening in the bottom of the testing apparatus, place sand to a depth of 5 in. over the plate, fill the container with oil having a viscosity of 70 sec. (Saybolt Universal) at 100 deg. fahr., bolt the top in place, and apply a pressure of 100 lb. per sq. in. over the oil. Conditions during the ensuing flow were noted. The sand used was a beach sand.

The following slot arrangements were tested:

Plate No. 1—1-in., 6-deg. included angle undercut slot.

Plate No. 2—2-in., 6-deg. included angle undercut slot.

Plate No. 3—1-in., 6-deg. through



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October 15, 1937.

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~~TRINITY~~ DRILLERS, INC.

ERNEST B. RUBSAMEN, JR.

mg

group of 3 slots, 13/64-in. bar between slots.

Plate No. 4—2-in., 6-deg. through group of 3 slots, 13/64-in bar. between slots.

Plate No. 5—continuous-grid, 3/16-in. square bars, 0.100 in. apart.

Plate No. 6—wire-screen, 8-mesh, 0.096-in. openings.

Plate No. 7—1 No. 39 hole (0.0995-in. diameter).

Plate No. 8—group of 13 No. 39 holes (0.0995-in. diameter).

A single 1-in. slot with 6-deg. undercut was used as the standard of comparison.

When plates No. 5 and 6 were used, the 2½-in. diameter of the side or bottom opening determined the amount of the grid or screen exposed to the sand. With the grid in place, 17¾ in. of slot was exposed.

A plate with a countersunk hole in the center was bolted under plates No. 3 and 4, and a run made with this plate in position for each slot width tested. The chamfered side of this plate was placed against the slotted plate.

The slot width in plates No. 1 to 4 was varied from 0.040 in. to 0.120 in. by 0.020-in. steps. Results of the test were as follows:

With single 1-in. and 2-in. slots the stable slot width was 0.080 in. and the maximum was 0.120 in., and with groups of 1-in. and 2-in. slots the stable slot width was 0.080 in. and the maximum slot width was 0.100 inches.

The maximum slot width with the plate backing the slots was 0.120 in., but with wider than 0.080 in. the slots filled completely with sand except opposite the hole.

With the grid in place, too much sand was made before a bridge formed. This was to be expected after the results obtained with the groups of slots. Sixteen times as much sand was made as was made by the single 1-in. slot.

With the screen, only about one-half as much sand mas made as was made by the grid. However, approximately eight times as much sand was made before bridging occurred as was produced through a single 1-in. slot of 0.100-in. width.

Plates No. 7 and 8 produced a stable bridge.

The instability of the group slots parallels the observations made on the instability of the bridging of steel balls due to the continual re-arrangement of the balls above the slot. These tests show that it is important that the spacing of slots should be such that a disturbance in the bridge on one slot will not break up the bridge on an adjacent slot. The minimum slot spacing at which proper bridging action takes place was not determined.

CONCLUSIONS. Spherical grains form stable bridges on openings larger than the diameter of the grain, the ratio being two for rectangular openings and three for circular openings.

Grain angularity and shape do not materially affect the opening size for a stable bridge, but do increase the "range of bridging."

In mixtures of two grain sizes of either spherical or angular grains, the bridging influence of the larger grain is great in relation to the amount present.

Stable bridging of typical unconsolidated oil sands occurs when the opening in the screen which retains 10 percent of the sample is taken as the diameter of the "bridging grain" and the rules for spherical grains applied.

The angle of repose of sand cannot be relied upon to produce bridging if the sand is saturated with fluid; hence, the position of slots does not affect bridging.

Undercut in excess of 2-deg. included angle is necessary to avoid clogging of the screen opening. It is desirable to avoid close spacing of slots, as it reduces the "range of bridging."

The results obtained are in reasonable agreement with those of other investigators.

The widest stable slot for broken consolidated formations can be determined from bailer samples, but cannot be relied upon because of the possible effect of water or producing conditions on the cemented grains.

The widest stable slot for well-consolidated sands cannot be determined by the methods outlined in this paper.

ACKNOWLEDGMENT. The author wishes to acknowledge the assistance of Mr. E. M. Wagner in the preparation of this paper.

J. S. SURFLUH

Prevention of Oil-Field Emulsions[1]

By J. S. SURFLUH[2]

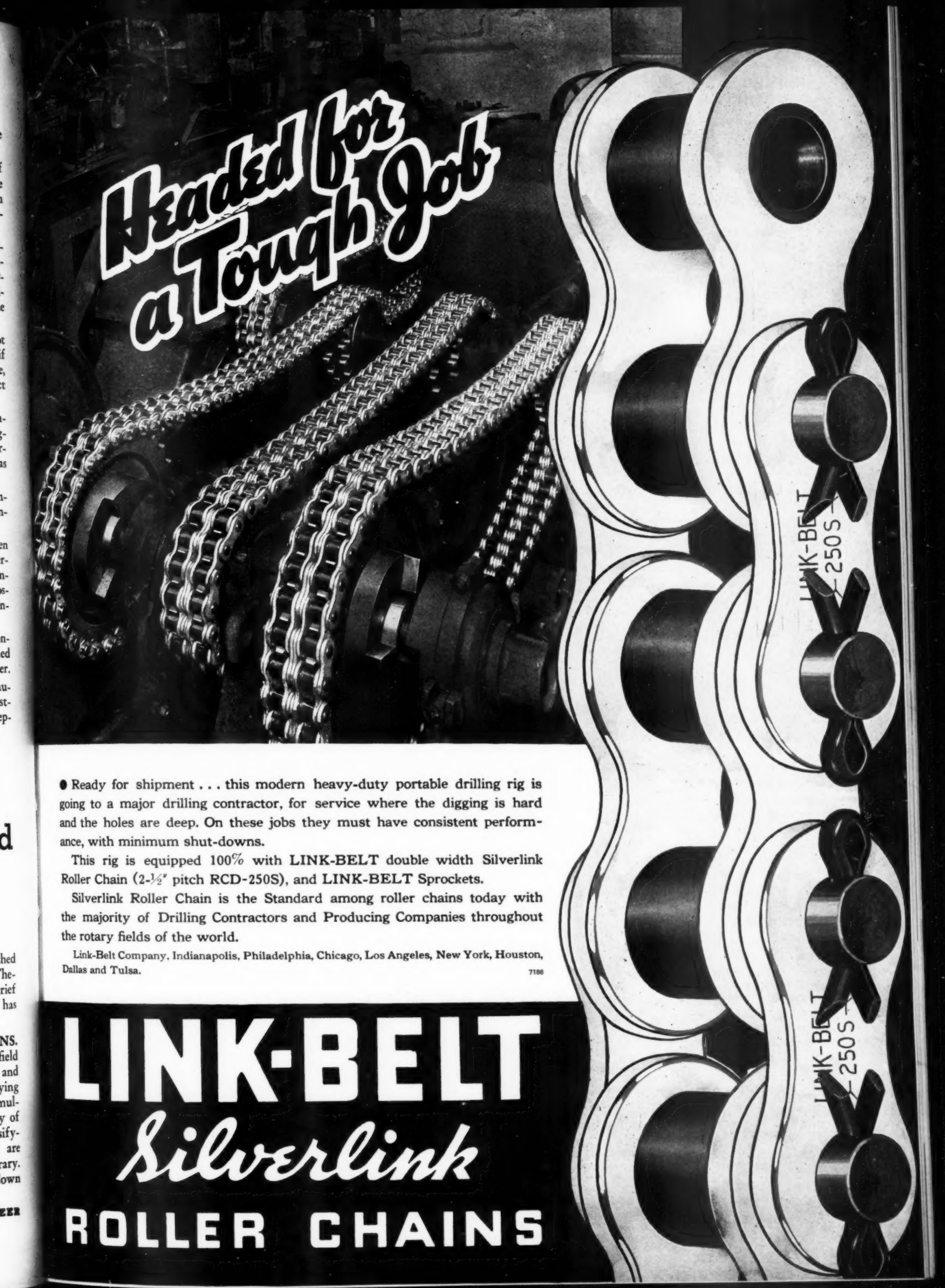
INTRODUCTION. The art of treating oil-field emulsions has been well developed, but more effective results can be expected by eliminating the formation of emulsions to as great an extent as posisble. Dehydration is often one of the principal items of lifting cost; and, whenever this is true, the important subject of prevention should receive special attention.

It is the purpose of this paper to present practical results accomplished in California oil-field practice. Theoretical discussion will be made as brief as possible, inasmuch as this phase has been adequately covered.

THE CAUSES OF EMULSIONS. The well-known cause of oil-field emulsion is the agitation of oil and water in the presence of emulsifying agents. The permanency of the emulsion is dependent upon the severity of the agitation and upon the emulsifying agents present. Emulsions are classified as permanent and temporary. A temporary emulsion will break down

[1]Abstract of paper presented at eighteenth annual meeting, American Petroleum Institute, Chicago, November 11, 1937.

[2]Standard Oil Co. of California, Los Angeles, California.



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into oil and water by settling methods alone. Any method of preventing the formation of emulsions in oil and water mixtures must either reduce the degree of agitation or must employ the use of chemicals to produce physico-chemical changes that will aid in emulsion prevention. The separation of all the water from the oil before the mixture has been agitated severely is a third possibility that occasionally can be used.

OIL-WELL PUMPS. From operating data, we conclude that oil-well pumps in perfect condition will produce some emulsion, provided the oil and water pumped can be emulsified readily; however, the quantity of emulsion produced is usually small until the pump becomes worn, whereupon the emulsion content of the oil increases greatly. Our knowledge of emulsions makes it evident that anything that will reduce the turbulence in the pump will aid in the elimination of emulsions; therefore, the following remedies should be considered in correcting conditions causing emulsions in oil-well pumps that are in good condition.

1. Decrease pumping speed.
2. Use gas anchor.
3. Decrease plunger spacing.
4. Maintain pump submergence.

Pumping wells that are producing excessive quantities of emulsions should be investigated for the above possible causes of emulsions. A preliminary test to determine the ease of emulsifying the oil will be of benefit. If the oil is easy to emulsify, all of these items should be considered.

The greatest source of emulsions is experienced from worn pumps. Dehydrating costs increase if worn pumps are used, because the emulsion content increases so greatly. In fields in which the production is practically free of sand, pumps wear very slowly, and the emulsion content of the pumped oil increases slowly with the age of the pump.

The injection of chemical down the casing of a pumping well will often prevent the formation of permanent emulsions in the pump. In many instances it is cheaper to treat the oil in this manner than to inject the chemical into the oil at the well head or in the lead line. When casing injection fails, it is because re-emulsification takes place due to excessive agitation in the tubing or lead line, or the chemical does not reach the bottom of the well. Sufficient chemical should, of course, be used to dehydrate the oil satisfactorily.

Tests must be conducted for each lease, and on representative individual wells, to determine whether "down-the-hole" treatment is justified. Electric dehydration may be cheaper, or treatment further along the oil-gathering system may be more economical.

TUBING TURBULENCE—Leaky Tubing. Tubing leaks, consisting of splits or leaky collars, produce very tight emulsions in pumping wells, and are often difficult to find if near the top of the string of tubing. Old strings of tubing cause a great deal of dehydration trouble because of leaks. The remedy is obvious.

SLIPPAGE AND GAS AGITATION. In flowing wells, and especially gas-lift wells, slippage of the rising column of fluid will, of course, produce emulsions. The oil and water in the tubing of flowing and gas-lift wells is often completely emulsified, with no free water present, according to samples taken in bombs from a connection on the upstream side of the flow bean. On the other hand, flowing wells and gas-lift wells, producing at uniform rates without much turbulence produce a great percentage of free water that can be settled out. It is believed that the correct size of tubing will obviate some slippage. Optimum gas-oil ratios also probably will help. However, no data of a practical nature are available to substantiate these statements.

From the known effect of gas in lead lines, it is believed that emulsions are formed in pumping-well tubing strings when the gas-oil ratio is high and the oil is easy to emulsify. The use of gas anchors should be of some benefit, as would high fluid levels and optimum casinghead pressures. These are merely suggestions that appear to be logical. No actual data have been procured to prove their effectiveness.

It is believed that excessive viscosities due to emulsion can be obviated by maintaining optimum gas-oil ratios. Entirely too much gas is often used to lift the production. When such a condition is encountered, it is suggested that an effort be made to reduce the quantity of gas used.

The turbulence is so great in the tubing of flowing and gas-lift wells that it is usually more economical to inject at least a major portion of the chemical behind the flow bean. Re-emulsification apparently takes place in the tubing. In three actual cases observed, 25 to 35 percent more chemical was required when it was all injected down the casing instead of all being injected behind the bean.

In pumping wells "down-the-hole" treatment is more likely to be economical, because less turbulence takes place in the tubing. The same data would apply as was given under the oil-well pump discussion.

FLOW BEANS. Flow beans used in flowing and gas-lift wells will cause emulsions if the oil and water have not been completely emulsified before reaching the bean, and if high velocities exist. The greater the pressure drop across the bean, the tighter the emulsion will become. Samples taken of oil on the upstream side of the bean and compared with samples from the downstream side, show that, if the flow is steady and not violent, with very low pressure drops, emulsions are not necessarily produced even though as high as 4000 bbl. of fluid are produced per day.

Preventive Methods. Chemical is often injected on the upstream side of flow beans for the purpose of preventing emulsions. This point of injection is nearly always the most economical place to inject chemical.

Water Traps (Squeeze Traps). Water traps have been used for separating water from oil, before the free water has become emulsified by its passage through flow beans or transfer pumps. The water trap is placed on the high-pressure side of the bean. Water traps are made out of casing, and are necessarily of small capacity because of cost. Tanks capable of withstanding the pressure may be used instead of casing. Such a trap is incapable of settling out any water unless the water is absolutely free.

Tests show that even many pumping wells do not produce sufficient free settling water to make such a method practical. Flowing and gas-lift wells often do not produce any free water in the top portion of the tubing.

LEAD-LINE TURBULENCE. Emulsions are often formed in the lead lines extending from the well to the oil tanks. The following causes and remedies will be considered:

Restrictions in Lead Lines. Wax accumulations will sometimes build up to the point where the opening in the lead line is reduced to ¼ in. or less, causing excessive pressures and resulting in leaks in tubing and pumps, and causing emulsions.

The remedy for wax deposition is to put a pressure gauge on the lead line at the well, and observe the increase in pressure. When the wax deposit begins to cause an increase in pressure, the wax should be removed. The circula-

tion of hot water has been used successfully, treating 500 ft. or less of pipe at one time. Frequently solvents are used, usually with heat. Occasionally heaters are used to keep the production heated sufficiently to obviate wax deposition in the lead lines. Wax trouble occurs during cold weather only. Sometimes fires are placed under the lead line, at intervals of 100 ft. or so, to melt out the wax or to prevent its deposition.

It has been reported that the continued injection of dehydrating chemical in the lead line at the well will obviate the accumulation of wax.

Excessive Bends and Fittings. This condition is not found very often, so little consideration need be given to this subject. Restricting fittings such as globe valves or regulating valves will create emulsions, and should be eliminated if possible.

Gas in Lead Lines. In many oil fields the casinghead gas is connected into the lead line for the chief purpose of saving the expense of constructing a separate gas line, although some operators prefer to liven the oil with gas, hoping to prevent wax accumulation in the lead line and to increase the gravity of the oil.

Many tests have proved that the casinghead gas is often responsible for the formation of additional emulsions. However, some wells produce oil that is difficult to emulsify; and, if the rate of flow through the lead line is low and agitation is kept to a minimum, very little additional emulsion is produced. Tests have proved that less chemical is required if the gas is removed from the lead line, although in some wells the economy effected would hardly justify the expense of providing a gas line.

Apparently, if the oil and water are nearly all emulsified at the well, the casinghead gas does little harm. The increase in quality and quantity of emulsion was greater in the production containing the least emulsion at the well.

GAUGING METHODS. The oil-gauging method in use effects the formation of emulsions. If gauge tanks are used and the oil cannot be gravitated out of the gauge tanks to the dehydrating plant, the oil must be pumped—which produces additional emulsion. Data procured in many pumping fields show that this method of gauging is responsible for a large percentage of the emulsion found in the oil, and that the cost of treating a barrel of gauged oil is often increased from 5 mills to 1 cent or more.

If wells are gauged for eight hours once a week, only 1/21 of the oil would be so handled; and, if it were possible to have the well convey the oil to the dehydrating plant at all times when not in gauge, the effect will not be nearly so severe as when all of the production is re-pumped. Gravitation of the oil from the gauge tanks does not cause emulsion if the velocity is not too great.

When pumping of gauged oil is required, the injection of chemical into the pump suction will aid in preventing emulsions. Less chemical will be required than if it were introduced into the pump discharge. Field tests made on many pumps, and on large quantities of oil, show that as much as 50 percent more chemical may be required when injected into the discharge line of the pump. It was found that the condition of the pump, as well as the type of pump, made a difference—excessive agitation always causing additional emulsion. Of course, when dehydration is accomplished electrically, chemical is rarely required.

The use of a suitable oil meter that can be made a part of the lead-line system will obviate the necessity of pumping out gauge tanks and will, of course, aid in eliminating the formation of additional emulsion in the oil. If the gauging equipment contains a pressure-regulating valve, controlling the oil flow, some emulsion may be formed when the oil passes through the valve; so the pressure drop should be maintained as low as possible.

TRANSFER PUMPS. It is intended that this heading should include all pumping or gathering of undehydrated oil after it has been brought to the surface of the ground, except gauged oil.

Tail pumps commonly were used for transferring wet oil in the past, and are still used to a lesser extent. In this service they operate a great deal of the time with only partly-filled barrels, because they are operated continuously and consequently are able to keep the receiving tanks pumped down to the suction-line level. This results in a great deal of emulsion being produced when the oil is wet. A practical remedy is to disconnect the tail pump as soon as the tank is emptied.

Modern practice consists of using electrically-driven reciprocating pumps that are operated only when there is oil to be pumped. The control is either manual or by float control.

If the terrain permits, the establishment of a gravity gathering system will usually obviate the formation of a great proportion of the emulsion that otherwise would be present due to transferring with pumps.

On some leases on which the oil is now gathered by pumps, tests have proved that if the oil could be dehydrated before being transferred, the cost of dehydration could be reduced 20 to 80 percent.

Of course, the oil and water both will have to be pumped unless they can be gravitated, but the saving in dehydration cost will usually more than justify the additional investment for a waste-water line and pumps. Some operators provide both a clean and a wet-oil line gathering system in the development of their leases—which, of course, will permit the wet-oil line to be used for waste water.

Additional reasons for treating the oil as soon as possible is that the deeper wells produce warm oil, and the well temperature thus can be conserved and used; also, emulsions become stabilized with age, especially during the first 24 hours.

The cost of the additional equipment required at these gathering points will vary considerably; but, if 1000 bbl. of oil are treated per day, an expenditure of from $1,000 to $3,000 will be required usually, depending on the equipment required and the method of dehydrating adopted.

CONCLUSIONS. The prevention of emulsions can be accomplished by:

1. Reducing the degree of agitation.
2. Producing physicochemical conditions unsuitable for emulsion formation.
3. Separating the water before agitation takes place.

All three methods are used, but the first is the most important.

The origin of oil-field emulsions can be ascribed to turbulence in the following places:

1. Well pumps.
2. Tubing.
3. Flow lines.
4. Transfer pumps.

Prevention in the last two groups has made the greatest amount of progress because of more opportunity to make large savings. However, the first two groups should be investigated, if any dehydration trouble is encountered or if the dehydrating costs are high.

Some operators have obtained greater dehydration economies by eliminating emulsions than by improving dehydration methods and equipment. For this reason, further investigation of this subject should prove of economic value.

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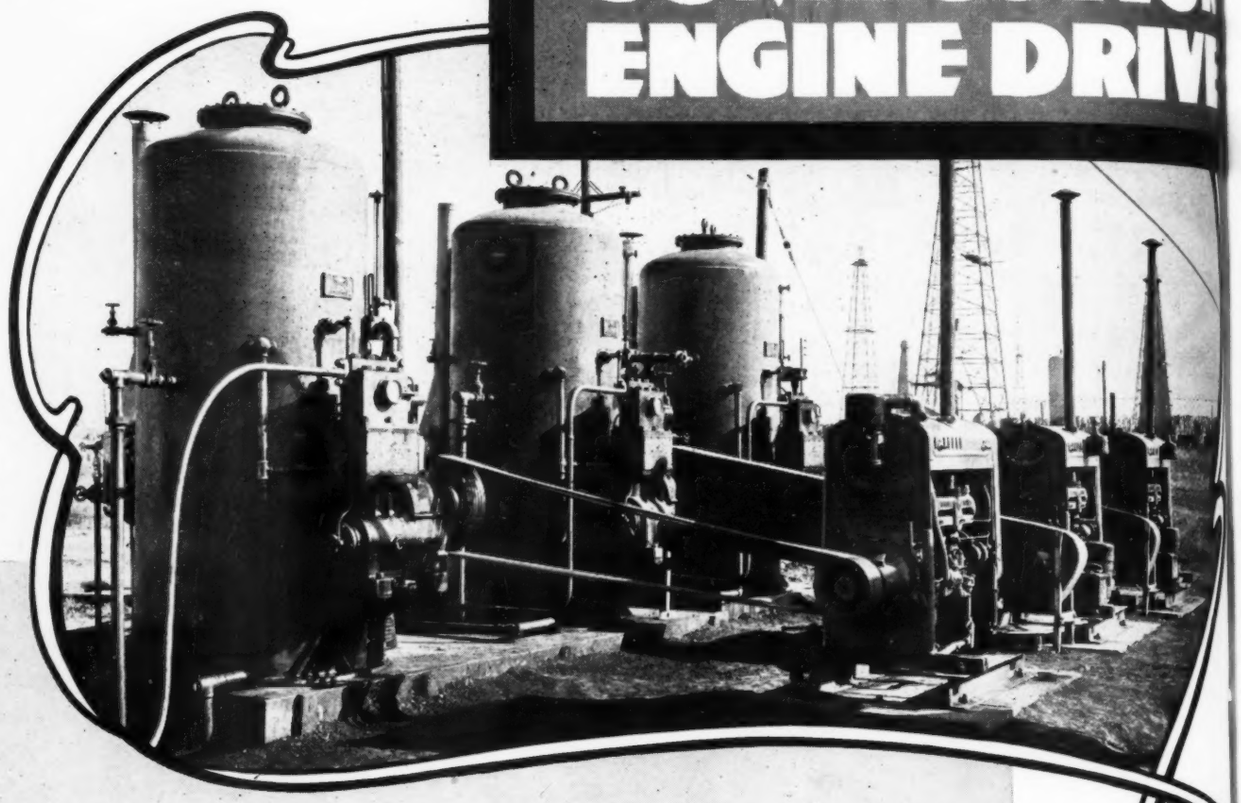

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Oklahoma City Field Pumping[1]

By B. M. MORONEY[2] and F. R. WHEELER[3]

B. M. MORONEY

THE production at Oklahoma City is obtained principally from the Wilcox formation, a uniformly-graded sand body having an average thickness of approximately 100 feet. During the period of natural flow Wilcox-formation wells generally produced tremendous quantities of sand. Reservoir pressures have declined to 30 lb. per sq. in. weighted average, but the wells still produce sand in amounts which require frequent reconditioning of the hole. The oil has a high paraffin content, and troublesome wax accumulations are encountered in producing at these low pressures. Wells having harmful quantities of free gas are becoming increasingly common; and it is not unusual to find, under static conditions, several hundred feet of frothy oil in the hole. There are also large quantities of water to be handled, particularly in some areas along the edge of the producing zone.

In the Simpson sand zone the problems are of a different sort. There the producing formation is a tight sand having reservoir pressures as high as 1000 lb. per sq. in. in some areas. Generally the wells produce large quantities of water, and do not have appreciable amounts of free gas.

Both the Wilcox and Simpson sands at Oklahoma City are encountered at depths of approximately 6500 ft.; and this fact, together with the problems outlined in the foregoing paragraphs, has placed secondary lifting methods at a decided disadvantage.

SUCKER-ROD PUMPING. The first pumping equipment to be installed in the Oklahoma City field was the regular standard-front long-belt and horizontal-engine type. During later months, however, the double-pitman unit pumper became the more popular. There are also a few long-stroke beam and pneumatic-head pumpers. The average beam-pumping installation including tubing represents an expenditure of approximately $11,000.

The problems encountered in sucker-rod pumping are listed as follows: sand, rod, paraffin, gas, and tubing.

SAND. Sand trouble has been the most serious problem of Oklahoma City pumping. This has been especially true of Wilcox sand wells, but has varied in different parts of the zone, as some areas seem to have less cementing material between the sand grains and, therefore, the holes cave more readily. Liners have not benefited the operators in most cases; because, where the openings were small enough to screen out the sand, they also sealed off production.

SUCKER ROD. The sucker rod presents one of the most difficult and expensive aspects of sucker-rod pumping. Failure of sucker rods has been the second highest cause of downtime. Production records point to the fact that little is actually known about sucker-rod behavior. Each well seems to be a problem in itself; and it is, therefore, impossible to forecast the behavior of any given type of rod. Low-carbon non-corrosive rods are more widely used than other types of rods.

The average rod replacement was found to be approximately nine rods per month, while 40 of the wells surveyed had average monthly requirements of 19 rods.

PARAFFIN. Heavy accumulations of paraffin in the upper tubing string often decrease production, because the rods fail to operate freely. In general, however, paraffin is a minor problem in beam-pumping wells, because it can be removed readily.

F. R. WHEELER

TUBING. Tubing generally used is 2½-in. external-upset 10-thread, and in most cases is anchored 2 ft. or 3 ft. off bottom. The alternate transfer of the liquid load from rods to tubing causes a corresponding elongation and contraction of the tubing. Excessive coupling wear has resulted from this movement, especially in the wells equipped with unanchored tubing. However, this wear also occurs frequently in the wells having the tubing anchors, and is probably due to faulty installation. The seriousness of this coupling wear has not been limited to loss of production only. Too often the well casing is damaged beyond repair by constant movement of the tubing, and the life of the well is shortened.

GAS. The elimination of free gas from the pump is an important factor in efficient operation. This can best be done by lowering the tubing to obtain maximum submergence. By this means the pump-intake pressures are increased, the gas tends to remain in solution, and thereby pump efficiency is rendered greater. At Oklahoma City the gas presents a real difficulty, because the average reservoir pressure has declined to approximately 30 pounds. During certain stages of development of the Wil-

[1]Abstract of paper presented at eighteenth annual meeting, American Petroleum Institute, Chicago, November 11, 1937.
[2]The Carter Oil Co., Oklahoma City, Okla.
[3]Barnsdall Oil Co., Oklahoma City, Okla.

cox zone, a "foam condition" of the oil has been experienced—resulting in major gas difficulties. In a few cases this has been overcome by raising rather than lowering the pump intake.

DOWNTIME. The average total downtime on sucker-rod pumping is approximately 10 percent. The causes of the downtime are analyzed as follows:

	(Percent)
Clean-out and sand trouble	50
Rod failure	25
Other mechanical failure, engine, rig front, pump, etc.	10
Tubing failure	5
Awaiting service	8
Paraffin	2

The over-all efficiency of power input to fluid output, of 15 electrically-driven beam-pumping installations, on which tests were made, averaged 27 percent.

HYDRAULIC PUMPING. At the present time there are approximately 40 hydraulically-actuated pumping units in Oklahoma City field wells. The pump is a reciprocating-type, and is submerged in the well. It is operated by means of hydraulic power, which is generated on the surface and transmitted to the pump through a string of small tubing inserted in the regular production tubing. The power oil is heated to reduce the viscosity, and is then filtered to remove sand particles before being pumped into the well. The production unit has a direct-connected engine plunger and pump plunger. The power oil from the engine end, together with the oil from the pump end, discharges into the outer tubing string. Ordinarily the ratio of power oil to production from the well is 1 to 1. The well conditions and pump speeds can be accurately determined by the action of a pressure gauge at the surface. The average cost of hydraulic-pumping installations, including tubing, at Oklahoma City is $10,000.

TYPES OF HYDRAULIC-PUMP TROUBLES. The problems encountered in the operation of the hydraulic pump are: sand, paraffin, power tubing, and mechanical troubles.

SAND. Caving sand has been the greatest factor in the downtime of the hydraulic pump, as it results in pulling and clean-out jobs. The oil to be used as power fluid must be thoroughly cleaned; otherwise the close-fitting valve mechanism cannot function.

PARAFFIN. Although paraffin is troublesome in all of the lifting methods at Oklahoma City, it is more so in the case of the hydraulic pump. Because the accumulation takes place inside the power tubing as well as outside, its removal is difficult. No system of preventing or removing the wax deposition has been found that gives more than temporary relief. The use of 500- to 1000-gal. batches of naphtha seems to be the cheapest means of reducing the working pressure. These treatments must be repeated every one to three weeks.

POWER TUBING. As it is essential that the power tubing be kept clean, it has been necessary to "pickle" and sand-blast in order to remove mill scale, iron oxide, etc. Incomplete cleaning has resulted in a material percentage of the downtime. Steps are being taken at present to overcome this difficulty by more thorough conditioning of the tubing. Furthermore, when the tubing is out of the hole, the ends are capped with closed protectors to exclude dust and dirt.

MECHANICAL TROUBLES. Mechanical troubles in the surface and bottom-hole equipment are the cause of around 10 percent of the downtime. As the pump is sensitive to starting conditions, it requires particular care at that time. Because the equipment is new to the oil fraternity, it is necessary to train the operating force at the time of the pump's installation; and because this method of pumping oil is a radical departure from conventional methods, there is much to be learned by the operators concerning its use. Therefore, it is reasonable to assume that mechanical difficulites will be overcome to some extent as experience is gained.

HYDRAULIC DOWNTIME. The average downtime of the hydraulic pump has been approximately 18 percent. The various causes of downtime are summarized as follows:

	(Percent)
Clean-out and sand	50
Paraffin	15
Mechanical troubles	10
Awaiting service	10
Dirt in power oil	10
Tubing leaks	5

As most of the hydraulic power is generated by means of electricity, it is a simple matter to calculate the over-all efficiency of the units. The efficiency, expressed as power input to fluid output is approximately 60 percent, a figure which is considerably greater than that for other methods.

SUBMERGED ELECTRIC CENTRIFUGAL PUMPING. In the electric centrifugal-type pumping, the motor and pump are suspended on the tubing, and are submerged in the well. Power is transmitted to the motor by means of a cable, which is clamped to the tubing string. The centrifugal-pumping installation represents an investment of approximately $13,000, which includes motor, pump, cable, etc. Costs of operation per day are high, but per-barrel costs are commensurate with other lifting methods.

The practicability of a centrifugal installation depends upon the following factors: sand, gas, and productivity of the well.

SAND AND GAS. Sand particles are particularly hazardous to the centrifugal pump. It rapidly wears away the impellers, and slippage becomes excessive. Wells thus equipped usually require more cleaning out than those with other types of equipment, because higher rates of flow wash more sand into the hole.

In gassy, frothy oil the centrifugal pump is decidedly handicapped. Fluids of less than 20 lb. per 100 ft. are common in the field. It has been found that the centrifugal pumps ordinarily fail to operate under these conditions.

Ordinary runs are approximately 60 days. Longer average runs are obtained in Simpson-zone wells, because there is less sand produced by these wells.

DOWNTIME. The downtime of wells equipped with centrifugal pumps is generally considerably greater than that of other lifting methods. The high percentage of mechanical downtime is increased somewhat, because it is necessary to send the unit to the factory to make all repairs and replacements. Ordinarily the operators have one replacement unit to every two or three wells.

The over-all mechanical efficiency of the centrifugal pumps at a depth of 6500 ft. has been found to be approximately 36 percent.

COMBINATION ELECTRIC CENTRIFUGAL — GAS-LIFT AND HYDRAULIC — GAS-LIFT PUMPING. Considerable progress has been made in gas-lift operations in conjunction with both the electrical centrifugal and the hydraulic pumps. These combination gas-lift pump methods are similar in that both the centrifugal and hydraulic pumps lift the well fluid a few hundred feet to a point above a packer, from which it is carried to the surface by compressed input gas. The reduction in discharge head enables the pump to handle more fluid than would otherwise be possible.

CENTRIFUGAL — GAS-LIFT. The centrifugal pump in combination with gas-lift has met with phenomenal success in producing the low-pressure Wilcox wells. It was found that as much as 5000 to 6000 bbl. per day could be lifted when the bottom-hole pressure was as low as 50 to 60 lb. per sq. inch.

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Wells in which excessive gas caused the oil to be in a foamy state, or wells which had loose sand, are less suited to this type of operation than those having heavier fluid and little sand.

HYDRAULIC—GAS-LIFT. The hydraulic pump in connection with gas-lift is a relatively new experiment which shows promise of being extended in the future in handling large volumes from low-pressure wells. Under this system it becomes possible for the operator to install equipment after the period of continuous gas-lift which can be used throughout the entire productive life of the well.

In the hydraulic-pump gas-lift method a larger than usual pump is connected with a regular-size fluid engine. The pump is run on 250 to 500 ft. of 5-in. casing, inside of which the power tubing is installed. Casing and power tubing are run simultaneously. A hydraulic-type packer is then installed, and the entire unit is lowered into the well on 3-in. tubing. Power tubing is then inserted in the 3-in. tubing, and is seated in a shoe in the packer assembly. Compressed gas is introduced at the surface in the 3-in. tubing, and enters the well casing above the packer. The power oil flows through the 1¼-in. tubing, actuates the pump, and joins the oil from the well produced between the tubing and casing.

Production of 1000 to 2000 bbl. per day has ben obtained by this type of lift without operating the units at capacity. The ratio of input gas required per barrel of oil produced ranges from 2000 to 3000 cu. feet. The production obtained between repair jobs has varied from a few hundred barrels to as high as 40,000 barrels.

The principal objection to the use of the hydraulic-gas-lift pump is that it is difficult to install and remove from the well. It has an advantage not found in the centrifugal-gas-lift pump, in that the pump speed and, therefore, the production of the well can be controlled at the surface by regulation of the power-oil input.

SUMMARY. For producing at low rates of flow, hydraulic and sucker-rod pumping are in direct competition with one another. At high rates of flow the centrifugal pump is outstanding. In general, there is little actual difference in the three pumping methods mentioned as to cost per barrel produced. Some operators, however, claim lower per-barrel costs with the hydraulic pump.

The advantages of sucker-rod pumping are: It is simple in principle, and the present personnel is fairly familiar with the equipment. The disadvantages are: It does not fit all types of wells, such as crooked holes; service equipment and labor requirements are large; it requires considerable replacement of material; and has the low over-all efficiency of 27 percent.

L. R. HODELL

Circumferential Field Welding of Casing[1]

By L. R. HODELL[2]

WHILE the welding of oil-well casing, including oil strings, is a proven success, the practice is as yet a relatively new one. For that reason, the methods and results here discussed are not presented as the best methods or the best results to be had in the welding of casing, but as the methods which we have used and the results which we have obtained. It is reasonable to suppose that other and better methods and results may eventually be developed or may even now be in existence.

THE WELDING PROBLEM. The first problem encountered in welding casing is the welding problem itself, which is really twofold. In the first place, the prime requisite to the whole process of welding casing in the hole is to have trained welders who are not only good welders generally, but men who have also been trained in the welding of casing. In the second place, it is an absolute necessity that the pipe be fabricated of readily-weldable steel.

THE FLOOR PROBLEM. The problem of acquiring the necessary equipment for the running of welded casing and the training of drilling crews in this operation is here called the "floor problem."

In the running of butt-welded casing, the first problem is to pick up the single joint from the walk and bring it into the derrick. In running threaded and coupled casing this is accomplished simply by putting a slip noose under the coupling. This, however, is not considered safe, even when manila rope is used, in the case of plain-end casing. For that reason it was necessary to devise something to take hold of the single joint of casing and pick it up—what we call our "pick-up clamp." It is hinged in the middle, and is tightened by means of a threaded toggle. Two grooves are cut around the inner surface of this pick-up clamp and filled with babbitt; and we believe that, when the clamp is tightened up, a better friction hold is obtained with the soft babbitt than with the bare steel.

After the single length of butt-joint pipe has been picked up, it is necessary to align it very accurately. This we do by means of our line-up clamp.

We find that it is well worthwhile to supply crews with electric hammers, which are driven by auxiliary generators on the welding generators. These hammers are powered by a 110-volt circuit.

In the handling of bell-and-spigot, or slip-joint, casing, it is not feasible to line up the casing by means of our

[1]Abstract of paper presented at eighteenth annual meeting, American Petroleum Institute, Chicago, November 12, 1937.

[2]The Carter Oil Company, Tulsa, Oklahoma.

The Harvest is Hard Won

To each of us the other man's business seems easier. We look at the farmer and think that there is a man who works with the good earth and reaps what he sows. We forget that seed may be infertile or untrue to strain; that only through eternal vigilance and persistent good fortune may the farmer's crop survive the tares and come to profitable harvest.

We look at the oil man and think that his business must be a rose with few thorns. We forget that he, too, reaps his golden harvest only through intelligent husbandry and that same eternal vigilance and good fortune.

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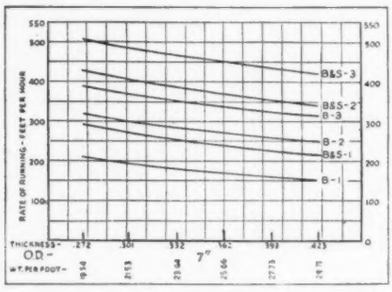


Fig. 1. Rate of running 7-in. outside-diameter welded casing

particular type of line-up clamp; so we accomplish this in a different manner. We use a Y-shaped device attached to the tubing board. This device is counter-weighted so that it rotates back out of the way except when actually held down in position by the weight of the man on the stabbing board.

When running butt-welded pipe, it is necessary to use a slip-type elevator. We have also used this type elevator when running belled-end pipe, but it would probably be possible to develop an elevator for the belled-end pipe that would work on the same principle as a regular collar elevator. We find it desirable to use a floor spider of the type in which the slips set themselves automatically and simultaneously by the release of a lever from which they are suspended.

The other side of the floor problem is the matter of training the men. The drilling crews who have never before run welded pipe present a major obstacle to progress in the beginning of a casing-welding program. The routine in the welding of casing being totally different from that used in the running of threaded and coupled pipe, the men find themselves more or less at a loss what to do.

TEST RESULTS. The next problem to consider is the joint problem. We do not claim to have established definitely the best type of joint, but we have conducted an extensive testing program, and are in possession of data that should be of interest. It was felt that possibly the most important single test that could be made on the welded joint was the full joint pull-out. A number of these tests, therefore, have been made in several different kinds of joints. The joints of casing which we shall discuss in this section have been welded by The Carter Oil Company's welders (see Table 1).

The joint efficiencies are calculated as the stress developed in the pipe at the time of failure, divided by the cross-section of the pipe wall, times the ultimate tensile strength of the pipe or of the electrode, whichever is the lesser. The determination of joint efficiencies involves a question as to what factors should be used; therefore, the data are presented sufficiently complete that any who may wish to do so may use some other method of calculation.

Referring to the data in Table 1, attention is called to the fact that in some cases failure took place in the sample outside of the weld and before the full strength of the pipe had been developed. These failures were chiefly due to eccentric loading which, in turn, was due to improper preparation of the samples. In the case of joints failing outside of the weld, we have tentatively given them 100-percent joint efficiencies, although we are perfectly willing to admit that this is questionable, and on such joints question marks have been placed after the joint efficiencies to call attention to them.

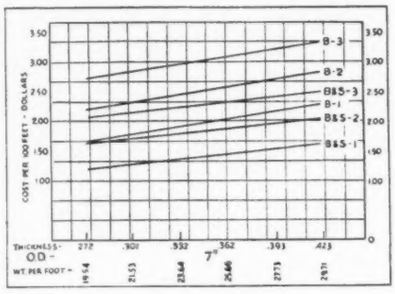


Fig. 2. Cost of welding casing

The results of this series of tests may be summarized by pointing out that, with the exception of the slip-joint weld, much higher joint efficiencies have been obtained than could be expected from threaded and coupled casing. In the case of the slip-joint weld, the results were discouraging. The reason for this is believed to be that, in running the casing, the two ends of the casing butt together within the threadless coupling and, when the weld is applied and the metal cools, contraction takes place, which builds up a considerable initial stress in the weld. The result is a considerably lower joint efficiency.

The tests have given results which, while not wholly anticipated, are statistically consistent. It is clear that the bell-and-spigot joint welded with two beads is superior to the straight butt-joint as we are making it. These tests, and subsequent examination of the samples after failure, show clearly that the reason for the failure of the butt joints in the welds is that we are not getting complete penetration.

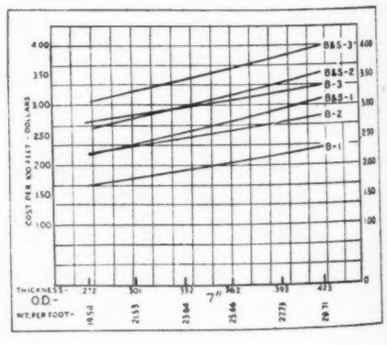
In summary we present two principal facts:

(1) The slip joint is consistently low in joint efficiency; and (2), all of the other types of joints are well above 80 percent on the average, even when we take into this average such low joint efficiencies as were obtained with the one-pass weld. It is apparent from these joint efficiencies that, by using good judgment in choosing the type of joint and the number of passes, and other technical considerations, it is possible to feel secure in an assumption of 90 percent or greater joint efficiency.

RATE OF RUNNING AND COST OF RUNNING WELDED CASING. To quite an extent, of course, the cost of running welded casing is a function of the speed, although cost is also affected by other factors caused by the usual conditions obtaining in production work. The principal difficulty in arriving at speeds and costs is due to the fact that in practice casing must always be run at some distance from the headquarters of the welding crew. By agreement with these welders, they are paid from the time they leave headquarters until they return, and it is not at all uncommon that the amount paid for any given job may be attributed more to the time going and coming from the job than to the actual time expended on the job.

In addition to this cause of higher costs and rates of running, we have a well-known source of loss in that it is never possible to set an exact time at which a casing job will commence. All producing operators are familiar with the last-minute delays which frequently put off the beginning of a casing job. For this reason, there are many instances in which welders are called out possibly as much as two or

Fig. 3. Cost of welded 7-in. casing joint



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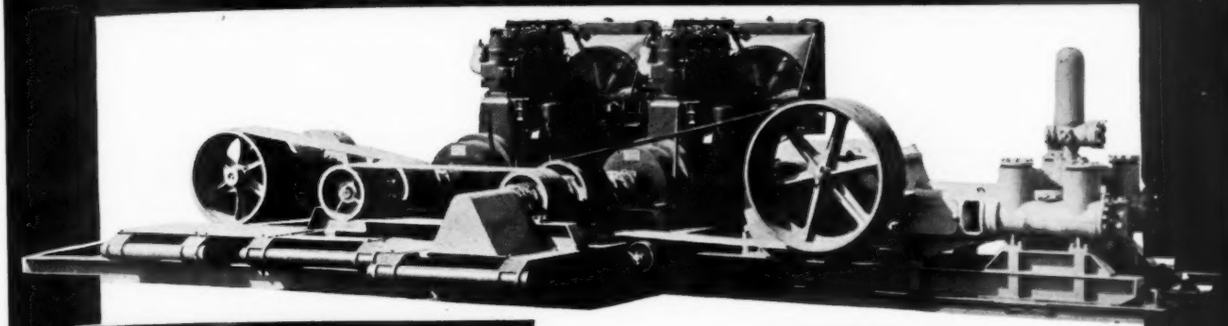

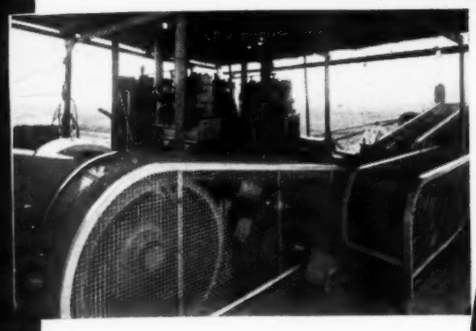

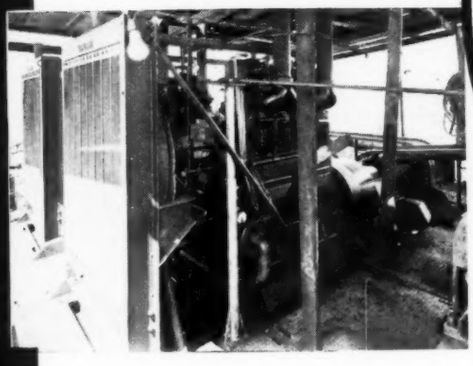

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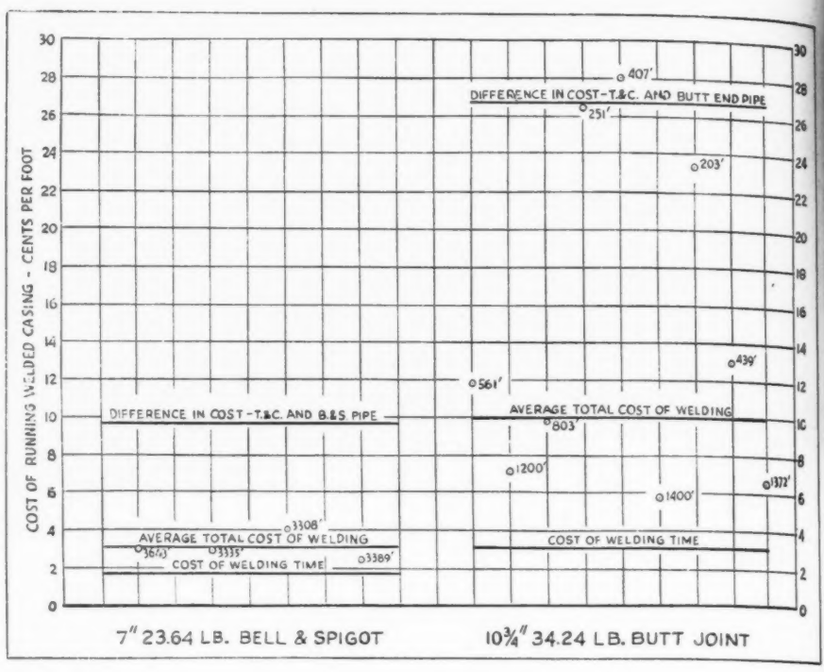

Fig. 4. Detailed costs of running welded casing

three hours before the drilling crew is ready for them to start. There are also the delays caused by the necessity for working over equipment during the running of pipe, and for the filling of the pipe with fluid as it is lowered into the hole. All these factors, which will be thoroughly appreciated by production men, make extremely difficult the accurate listing of time necessary for accomplishing the running of any given size and weight of pipe.

In giving first the figures for the time required to run casing, it should be understood that these are in no way record times; that no effort has been made to set out here the best times that we have ever made. With this explanation attention is called to Fig. 1, which represents the rate at which 7-in. casing can be welded into the hole, using from one to three welders and using the bell-and-spigot and the butt joints. It should be pointed out at this time that these are average rates for casing strings of varying lengths. We find that in running very short strings the time is always abnormally long, due to the fact that neither the welders nor the drilling crew has sufficient opportunity to get into the swing of it. In long casing strings the routine settles down and functions smoothly after about the first hour.

The rate of running decreases as the diameter increases; this rate nevertheless may be maintained in practice at a fairly high level by reason of the fact that the larger the casing, the greater the number of welders that may be employed in the running.

The running of bell-and-spigot pipe is noticeably faster than the running of the butt-end pipe. A rough overall figure probably would be that in any given length of time 25 percent more bell-and-spigot pipe can be run than butt-joint pipe.

We find that we can operate a welding machine mounted on a truck, and manned by a welder and helper, for $3.50 per hour. This cost will include the wages of the welder and helper, and the maintenance and depreciation of the truck and welding unit, and the consumption of electrodes. This charge is made regardless of whether the unit is running or whether it is in transit to and from the job, and it is possible from this charge and from the times already given for the running of various sizes of pipe to arrive at the costs of running this pipe. As has already been pointed out, these will be costs only of the work actually done from the time the first joint goes into the hole until the pipe is landed. We do not take into consideration the charges that must be made for the crew and the equipment on its way to and from the well, or while waiting at the well. These costs, however, are basic; and, while they are never attainable, they serve as a guide to what the least cost might be theoretically. After having shown these costs, it will be indicated that they are only one-half to one-third the actual costs of running casing as we have experienced it. Fig. 2 gives the basic costs for the running of 7-in. casing.

The costs here have been set up on the basis of 100 ft. of casing, it being assumed that the casing joints will average 40 ft. in length.

Prices of pipe are such that butt-end pipe is usually quoted as so many percent less than threaded and coupled pipe. Then, if it is desired that the pipe be belled for welding, the usual charge for such belling is $1.00 per ton. For this reason, the bell-and-spigot pipe is slightly more expensive than the pipe bevelled for butt welding. Therefore,

TABLE I
Results of Full-Joint Pulls of Welded-Joint Casing

Sample No.:—	1	2	3	4	5	6	7	8	9	10	11
	7-In. 24-Lb. Grade "C" Bell-and-Spigot	8⅝-In. 36-Lb. Butt-Joint	8⅝-In. 36-Lb. Slip-Joint	8⅝-In. 36-Lb. Butt-Joint	8⅝-In. 36-Lb. Slip-Joint	8⅝-In. 36-Lb. Butt-Joint	8⅝-In. 36-Lb. Slip-Joint	7-In. 24-Lb. Grade "C" Bell-and-Spigot	8⅝-In. 36-Lb. Double-Bell and Chill-Ring	8⅝-In. 36-Lb. Double-Bell and Chill-Ring	8⅝-In. 36-Lb. Slip-Joint
Measured average thickness, in.	0.339	0.4125	0.406	0.410	0.406	0.411	0.413	0.337	0.40	0.40	0.40
Pounds pulled when failure occurred, lb.	531,600	871,100	654,900	550,600	790,000	552,200	483,000	523,500	792,500	838,400	608,600
Stress in sample at time of failure, lb. per sq. in.	74,454	81,335	64,395	52,841	77,679	52,691	46,802	72,911	77,925	82,438	59,843
Joint efficiency, percent.	100	100	74.66	100(?)	90.06	61.06	55.06	100	100(?)	94.12	70.40

Joint efficiencies based on strength of electrode, which had an ultimate tensile strength of 85,000 lb. This electrode was used because the manufacturer's minimum guarantee on this casing was 85,000 lb.

ISCO REVERSE CLUTCH

for DEEP DRILLING *offers*

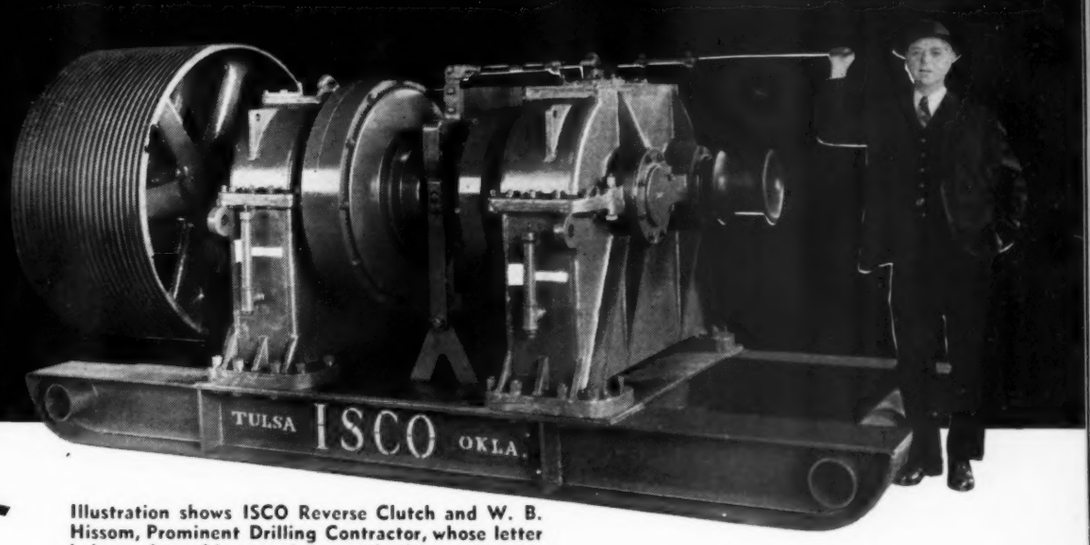

Illustration shows ISCO Reverse Clutch and W. B. Hissom, Prominent Drilling Contractor, whose letter below relates his experience with this equipment.

MAXIMUM CAPACITY and MINIMUM UPKEEP

Just sixteen months on the market have proven ISCO Reverse Clutches offer more advantages than any other reverse clutch. They have established enviable records for ease of operation and freedom from repairs.

Because the inertia of moving parts that change direction of rotation during reversing operation is much less than on conventional old style clutches, and because of ball-bearing mounting of the operating lever, the ISCO Reverse Clutch has a smoothness and ease of operation described by drillers as "more like steam than any other Reverse Clutch ever used."

Hissom Drilling Co. has drilled ten wells with an ISCO Reverse Clutch "without being touched except to add oil."

FEATURES:

- Heavy Structural Steel Base.
- Semi-Steel Ribbed Cases.
- Roller Bearing Shafts.
- Forward Drive by 2½" Triple Roller Chain.
- Cast SAE Alloy Steel Herring-Bone Gears.
- Only One Light-Weight Double Cam, Limited Movement.
- Adjustable Friction Plates.
- Bayonet Type Gauges for Checking Oil Level.
- Welded Construction.
- Hammer Forged SAE Chrome Nickel Steel Shafts.
- Oil Bath Lubrication for All Moving Parts.
- Forged Cut Tooth Sprockets.
- Single Lever Forward Control.
- Reverse and Neutral Positions Pivoted on Ball Bearings.
- Alemite Lubrication for Operating Lever and Clutch Yoke.

Write for Literature

OKLAHOMA		KANSAS	
Tulsa	Oklahoma City	Chase	Great Bend
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DRILLED 10 WELLS

"Without Being Touched Except to Add Oil"

HISSOM DRILLING COMPANY
THOMPSON BUILDING
TULSA, OKLA.
October 21, 1937

International Supply Company
Tulsa, Oklahoma

Gentlemen:

In August of 1936 we purchased one of your ISCO Reverse Clutches for use on a Waukesha powered mechanical rotary drilling rig. We have drilled ten wells with this clutch without any trouble whatsoever, and have changed oil only once during that time.

All of our drillers prefer this clutch to any other they have ever used as it is easier to operate and much more efficient.

Yours very truly,
HISSOM DRILLING COMPANY

WBH:c

By: W. B. Hissom
President

GREATEST
Ease of Operation.
Freedom from Repairs.

INTERNATIONAL ISCO SUPPLY COMPANY

INTERNATIONAL SUPPLY CO.

▶▶▶ TULSA, OKLAHOMA ◀◀◀

if the cost of the welded joint to the consumer is considered, i.e., if $1.00 per ton be added to the cost of welding the pipe, there will result the values shown in Fig. 3, which is for 7-in. casing. In this case the cost of the welded joint for bell-and-spigot pipe, in spite of the fact that it is welded more rapidly and more cheaply, is greater than the cost of the butt joint. The general magnitude of this difference is about 1 cent per foot.

The slip joint would run roughly 4 cents per foot higher than the butt joint, and would weld at the same rate as the bell-and-spigot joint. The double-bell and chill-ring joint would run about 3 cents higher per foot than the butt joint, and would weld slightly more rapidly than the butt joint. While we may conclude that the bell-and-spigot joint is the most rapid joint, it is not a fair conclusion that it is the cheapest joint—the cheapest joint to weld being the butt joint.

Fig. 4 shows actual costs taken from our books, after all charges have been made for everything pertaining to the job. On the left is shown the information for 7-in. 24-lb. casing, with a wall of 0.332 inches. The lowest horizontal line shows the cost of the welding time. The various points indicated above this cost are actual costs, and the second horizontal line is the average of these actual costs. The right-hand side of the figure shows a similar set-up for 10¾-in. pipe. Examination of these figures allows us to point out one further factor in the variation of cost, viz., the effect the length of the string will have on the cost. In figuring actual over-all costs, it is obvious that if a welding crew is sent out to weld 200 ft. of casing, they will have to add a very high percentage of cost to the actual cost due to the time they are coming and going. This is well illustrated in some of these actual costs.

CONCLUSIONS. The principal requirements for the successful welding of casing are: (1), casing of a steel which is readily-weldable; (2), trained personnel to do the welding; (3), certain tools that will facilitate the handling of the casing in welding.

The results obtained in welding casing, as indicated by the full-joint pull tests, are very encouraging. It is apparent that joint efficiencies of 80 to 100 percent can be easily attained in quite a number of different joints.

The cost analyses of welding casing clearly show that, with the discount obtained for casing for welding as compared with the cost of threaded and coupled casing, it is possible not only to pay for the welding, but also to obtain a respectable profit.

The net result of welding casing is to make for cheaper pipe strings, with greater joint efficiencies, which probably means a greater ultimate recovery of pipe; we should be able to have pipe strings that will not leak.

Operation and Maintenance of Multi-cylinder Gas Engines[1]

By H. R. HOGABOOM[2]

THE present paper summarizes the principal conclusions of the committee discussions concerning ignition, carburetion, starting, lubrication, cooling systems, mechanical maintenance, and magneto vs. battery ignition. For the sake of brevity, the subjects of ignition and of battery vs. magneto ignition have been combined.

IGNITION. The ignition system as a whole is undoubtedly the largest single factor in multiple-cylinder engine maintenance. It is probably the least understood by the average layman.

The magneto is simple, has few parts, is compactly assembled into one unit, and requires a minimum of outside wiring and connections. It is claimed that the magneto consumes less power than the distributor and generator. The theft hazard is less than with batteries. The magneto can be made dust-, moisture-, and explosion-proof.

The magneto results in very short shut-down periods for service, when all testing and servicing is done in the shop. In case of ignition failure in the field, the complete magneto is removed and a new one installed in a few moments; whereas with battery ignition, a systematic test would be required in the field covering battery, distributor, coil, condenser, wiring and generator, with a full replacement of the defective part.

As for the battery system, it is conceded that the real reason for its existence is the availability of the electric starter. The storage battery seems to be the big item in question, because of the probable service expense in excess of that for the magneto, and the greater possibility of theft, especially in connection with units that are shut down.

Magneto failures can be divided into two groups: electrical and mechanical, with the former considerably in the majority.

Mechanical failures may come from poor alignment of drive couplings; failure of the impulse coupling; bearing troubles, usually caused by excess or insufficient oiling; mechanical defects of the distributor and breaker, or interruptor.

Excessive wear or failure of the drive and impulse couplings is usually due to improper magneto alignment, which should be checked monthly. Bearings are usually excessively oiled.

Electrical breakdown of the magneto can usually be traced to overloading—the load being a function of spark-plug gap, engine compression, and leakage between the point of electrical generation within the magneto and the spark-plug electrode.

The wiring should be kept dry, free from breaks in insulation, and cool. Chafing should be eliminated, and metal conduits avoided.

The timing of the electrical discharge or "spark" within the cylinder is important, and varies with such factors as speed, compression ratio, combustion-chamber design, and plug location.

Spark plugs are a very important item of maintenance. The multiple-electrode type is favored. A "cold plug" is generally adapted to natural-gas service.

CARBURETION. Due to the uni-

[1]Abstract of paper presented at eighteenth annual meeting, American Petroleum Institute, Chicago, November 12, 1937.

[2]Petroleum Equipment Company, Los Angeles, California.

versal use of natural gas as a fuel for oil-well pumping engines in California, other fuels have been disregarded in this discussion.

1. Supply of Gas to the Engine. All our efforts in this connection are directed to the one end—to obtain a supply of gas that is clean, of constant heat content, and constant pressure. As simple as these requirements may seem, they are seldom found in the field.

Lack of cleanliness is by far the worst enemy, and more trouble is caused by foreign matter in the fuel supply, both solid and liquid, than by any other single item. The principal trouble is probably due to water. Precautions should always be taken to remove this water, and any other liquids, before the gas is fed to the engine carburetor.

All carburetors operate under a very low pressure, and it is never feasible to try to operate the field distribution system at a pressure that will permit delivery of the gas direct to the carburetor. A pressure regulator, or reducing valve, therefore is employed between the gas supply and the carburetor.

2. Mixture of Gas and Air at the Engine. The problem of carburetion is complicated by the fact that:

a. The gases handled, air and fuel, are under different pressure.

b. A wide air-gas ratio is necessary to meet varying heat content of different fuel gases.

c. Positive control of mixture for starting is essential and, on the "rich" side, the possible decrease in air-gas ratio is very small.

The problem has been attacked by the use of diaphragms or floating members for control of gas supply. The admission of just the right amount of gas during the cranking or starting operation is the big problem, and each manufacturer has provided adjustments for idling or starting, carefully set under test conditions at the factory. The most important item to watch out for is the positive shut-off of gas when the engine is down.

Due to the large amount of air handled in the long periods over which these engines operate, it has been recognized from the start that air cleaners should be employed.

3. Maintenance of the Entire System. In reviewing the system, the logical place to start is the high-pressure gas-supply facilities. Be sure that the lines are graded, and that drip pockets are installed where possible, particularly at the end of any long run.

Install the regulator in such a way that it can be easily serviced; and at least once every six months inspect it, testing the pressure and cleaning the seat of the valve.

Watch the hose connection, as there is a tendency for flakes of rubber to break loose on the inside and cause a stoppage of the flow.

If there is a filter on the gas line, clean it every 60 or 90 days.

See that the air cleaner is filled to the proper level with clean, light oil. Remove it at least every six months, clean it thoroughly by washing in some solvent, and then refill to the proper level only.

As for the carburetor itself, keep it clean, periodically inspect it to see that it is clean, but do not change the adjustments or settings until certain that some other item is not the cause of the trouble.

STARTING. Difficulties which arise in starting engines are almost automatically divided into the two groups:

1. Initial starting of a new engine.
2. Starting of an engine that has been in service and has gone "dead" for some unknown reason.

The greatest difficulty in starting a new engine is caused by contamination or improper pressure of the fuel supply. Be sure the mains have been thoroughly blown out and that no air remains in the pipes or scrubber, and do not "tinker" with the carburetor adjustments until all other possibilities have been exhausted.

The problem of starting an old engine, one that has been deliberately shut down for some reason, or one that has gone "dead" while in service, is not so simple.

It is common practice to equip all engines used in the fields with oil-pressure and water-temperature safety devices. There is a good probability that, if an engine has stopped during service, one of these devices has performed its natural function and shut the unit down due to low oil pressure or high water temperature; or has failed within itself, and should be replaced. The operator on such a call should proceed as follows:

Examine the level of water in the radiator, and of the oil in the crankcase. Finding one deficient, immediately locate the trouble. Finding both satisfactory, disconnect the wires to the safety devices—and the engine should start. By applying the wires to the devices while the engine is running, it is a simple matter to locate the trouble and correct it.

By all means do not permit anyone to disconnect the safety wiring and then leave the installation in operation before it is serviced. A competent service man should look for the cause of the trouble, which may be loss of water circulation, broken fan belts, excessive load from some unexpected source, lack of oil pressure due to the failure of the oil pump, broken oil lines, sludged-up oil screen, or some other cause of trouble which the pumper can perhaps not readily locate.

If the engine has stopped due to some cause other than failure or normal operation of the safety devices, the following procedure is recommended to determine the reason:

Begin on the ignition system; and, if there is no spark at all, it is suggested that it will usually save time if the complete ignition system is gone over at once.

The determination of compression is not complicated. An experienced man can tell immediately by the "feel" of the crank handle whether or not he has lost compression. If the compression is very low, no amount of cranking will start the engine, and a mechanical checkup and service is necessary.

The question of fuel supply as related to starting is extremely important, running neck and neck with ignition troubles. If the engine has good or medium compression, and there exists a fat blue spark at the plugs, it is quite evident that there is some deficiency in fuel supply.

Determine first if any gas is reaching the carburetor. If not, the cause of the trouble is evident. If gas is reaching the carburetor, determine at what pressure, through the use of common U-tube or pressure gauge. Assuming now that the gas pressure is within the proper range, the ignition is correct, and still no explosion results through cranking, it should be determined if the carburetor has been leaking to such an extent that it permits enough gas to pass into the manifold and cylinders to cause a mixture too rich to burn, commonly called "flooding."

The common types of 6-volt and 12-volt battery starters have been used, with batteries installed at each well. The first cost of the installation, plus high maintenance of storage batteries, has prevented the wide adoption of this system of starting. Other systems have been tried but have not been found to be advantageous.

LUBRICATION. Unquestionably the most controversial subject that arises in connection with gas engines is that of lubrication. We must remember that, while the average multi-cylinder engine resembles an automotive engine —in fact, many of the types used in the oil fields are also used in trucks— its operating conditions and service re-

When it is time to move,

Electrically driven equipment has higher salvage value

They tell me that in the oil business nearly everything is done with one eye on the time when it will be necessary to do something else. If that is the case, electrically driven equipment has a natural advantage over anything else.

Electrically driven equipment has a high salvage value. Electric motors seldom wear out. Electrically driven machinery is smoother in operation, and does not shake itself to pieces. When it is necessary to move it, it is in good condition. No expensive repair jobs are necessary to make the equipment fit for service at another location.

It costs less to salvage electrically driven equipment. Part of the cost of salvaging any equipment is the labor required to tear it down and move it. Electrically driven jobs require less labor to tear down and move because they are lighter, more compact, cleaner, and easier to handle. Smaller and lighter transportation equipment can be used.

High salvage value is only one advantage of electrically driven oil field equipment. Other important advantages are lower first cost, less depreciation, less taxable value, less labor for operation and maintenance, less shutdown time, smoother operation, higher efficiency, and no water or fuel lines.

All of these advantages of electric drive are available to operators in East Texas and Rodessa. Cheap and dependable electric power is available from the lines of the Southwestern Gas & Electric Company in both fields. Service is excellent. Rates are low, and are designed particularly to fit oil field operating problems.

If you require power in East Texas or Rodessa, write, wire, or telephone the Power Sales Department, Southwestern Gas & Electric Company, Shreveport, Louisiana.

SOUTHWESTERN GAS & ELECTRIC CO.

quirements are quite dissimilar, and require a different technique.

There is some disagreement as to just what sludge is, but there is one common point of agreement: A non-emulsifying oil, such as turbine oil, will greatly reduce the formation of sludge. It is quite certain that sludge formation can be kept at a minimum by:

1. Reducing the blow-by past the piston rings.
2. Ventilating the crankcase.
3. Raising the crankcase temperature.

Blow-by is a function of the mechanical condition inside the engine cylinders. Whether or not remedial work is advisable in a certain engine, for the single purpose of bettering the oil condition, is a question that must be decided by the field men having the history of the engine.

Crankcase ventilating serves to carry off the water vapors in the crankcase before condensation. This remedy is linked closely with crankcase temperatures; because it is self-evident that, if crankcase temperature is low, the vapors condense very rapidly and ventilation is ineffectual.

Crankcase-oil temperatures follow quite closely the radiator temperatures. Field tests show definitely that, insofar as oil condition is concerned, the operating temperature of the radiator should be kept close to the boiling point.

Much work has been done with filters during the past year, and many oil reclaimers are in use. Complete results as to the over-all benefits to be obtained will require a long period; but it appears certain that the time between oil changes can be materially increased by the use of these reclaiming filters. A suction screen on the oil pump, and an additional filter of some type to catch those solids in the oil that are too small to be held by this screen, should be used.

Tests with operating temperatures indicate that oil coolers would be a detriment rather than benefit.

COOLING SYSTEMS. Cooling systems are many, both direct and indirect, closed systems or open systems; and in this group we find cooling towers, radiators, heat exchangers, and pot-type dissipators. Radiator systems only will be discussed here.

The secret of any cooling system is the proper balance of the three major items directly related to cooling, viz., the radiator, the pump, and the fan. The water pump must be properly designed, and must be of ample capacity to handle through the motor between one-half gal. and 1 gal. of water per minute per horsepower.

Design of fans is wide and varied, and quite a bit of controversy is indulged in relative to the merits of low-speed fans over high-speed fans. A fan with six or eight blades, operating at a low speed, will develop more wind velocity with less horsepower than a high-speed fan of smaller diameter and fewer blades.

The efficiency of an internal-combustion engine goes up in proportion to the temperature. However, as the temperature goes up, the horsepower output of the engine goes down, because less fuel can be burned per cycle. The practical temperature limit at which the engine can operate will be the temperature at which water boils.

A fault to find with extremely-hot operating engines is the fact that, with higher temperature, there is greater loss of water and, in turn, engines have to be watched more carefully. Also a hot operating engine has a tendency, in the majority of cases, to carry more of the oil in a vapor spray in the case. This causes excessive oil consumption.

In operating any multiple-cylinder gas engine below 140 deg. fahr., certain sections of thin metal on the engine will be below this point; and, with the possibility of blow-by and with the steam that is bound to pass, these thin sections of metal are an excellent medium of condensation. Cold operation is a major contributor to emulsion, and also to valve-spring fractures.

The majority of troubles which occur in engines come from operating at too low a temperature—in some instances causing the loss of bearings from emulsion in the crankcase, or broken valve springs and stuck valves. Thermostats have been used, both of the closed and by-pass type. These have worked very satisfactorily in some instances, and in others have given no end of trouble.

Shutters have also been used, but not with any great degree of success. Work is being done on the variable-pitch fan of the airplane type of multiple-blade construction, thermostatically controlled. This is, however, in the experimental stage.

The following represent a few helpful hints in the proper maintenance of a cooling system: First of all, the water used in the system should be a very soft water — although not necessarily distilled, as distilled water sometimes contains carbonic acid. The best water that can be used in a cooling system is taken from a large still body of water.

Another difficulty encountered in the proper maintenance of radiator equipment, which has been given very little thought by the average maintenance man, is the passing of the products of combustion into the cooling water due to a slightly-loose cylinder head. Keep the cylinder heads tight.

The water pump leaking is another source of trouble, because any leak that is apparent in the engine is a potential entrance for air.

The fan belt of the engine must always be maintained in proper adjustment, and the external portion of the radiator core should be kept as clean as possible so that the air through the core will have a direct contact with the core metal to give maximum cooling. Thermostats and water-temperature safety plugs should be removed at 60- to 90-day intervals, and properly cleaned.

The importance of the radiator shroud is very often under-estimated. A properly-designed and located shroud will greatly increase the capacity of any radiator and fan combination, by increasing the quantity of air handled by the fan and by causing a more even flow of that air over the entire surface of the radiator.

A recent development is the thermostatically-operated multiple shutter using the intake manifold vacuum as the motive power to move the shutters.

MECHANICAL MAINTENANCE. Mechanical maintenance can be hurried over very briefly for the reason that it represents a very small fraction of the total engine service. With good lubrication, proper operating temperatures, reasonable load and speed, engines have been known to operate continuously for periods of four years with no mechanical repairs. This is not the average, but does represent a possibility when conditions are right.

Undoubtedly the valve mechanism as a whole will require at least half of all mechanical work. By this term is included the valve seats, valves, valve guides, valve springs, tappets, and push rods and rocker arms, if the engine is of the overhead-valve type.

Pistons and rings may give some trouble; but, if standard clearances are adopted and adhered to, and if the lubricating oil is kept in condition, there will be very little trouble with these parts.

Bearing trouble is almost unknown. With mean effective pressures of 60 lb. or less, and with piston speeds of approximately 1000 ft. per min. and under, bearing failures can be traced in every instance to some other cause than normal wear and tear.

In general, do not continually tinker with the mechanical parts of the engine; a smooth-running engine is a good engine to leave alone.

Running Tour
WITH MEN IN THE INDUSTRY

J. E. F. De KOK, general managing director of the Royal Dutch Petroleum Company, has completed a business trip to South Africa and returned to The Hague. The entire trip was made by plane.

E. H. CUNNINGHAM CRAIG, consulting geologist of London, is visiting Trinidad properties owned by some of his clients.

J. R. CREE, superintendent of the Lago Oil Company of Maracaibo, Venezuela, is spending a vacation in Olney, Illinois.

C. H. LIEB, Tulsa, Oklahoma, president of Carter Oil Company, has been made vice-president of the Standard Oil Company of New Jersey, and transferred to New York City, and **J. J. CONRY,** Tulsa, vice-president of Carter Oil Company, succeeds Lieb as president. **F. W. FLOYD,** manager of production, and **L. F. McCOLLUM,** manager of explorations, have been made vice-presidents.

ARTHUR G. LEVY, chairman of the southwestern district of the production division, American Petroleum Institute, and formerly an engineer with The Texas Company at Shreveport, Louisiana, has been made production manager of the Crown Central Petroleum Corporation at Houston, Texas.

F. E. STEELE has been made district engineer at Shreveport, Louisiana, by the Phillips Petroleum Company. He has been in the Bartlesville, Oklahoma, office of the company, and succeeds **R. W. STEWART,** who has been transferred to the engineering department at Bartlesville.

H. H. SPAIN has been made superintendent of the Friendswood, Texas, district by the Humble Oil and Refining Company.

W. E. SCHOENECK, who has been district engineer for The Ohio Oil Company in the East Texas field, has been promoted to division engineer, his headquarters now being in Shreveport, Louisiana.

M. T. SMITH has been made head of the crude oil purchasing division in West Texas and New Mexico for the Shell Petroleum Corporation. He has been transferred from Houston to Midland, Texas.

C. J. NOBMANN, of the Shell Oil Company, San Francisco, California, has been named Pacific Division chairman of the Petroleum Section of the National Safety Congress.

HARUKICHI TAKAHASHI, Taihoku, Japan, petroleum engineer for the Formosan government, was a recent visitor in the Gulf Coast area.

W. S. CRAKE, mechanical engineer, Southwest Texas Division, Shell Petroleum Corporation, has accepted a position as mechanical engineer with the United British Oil Fields of Trinidad and will make his headquarters at Port-of-Spain, Trinidad.

H. W. EASTMAN has been placed in charge of the newly-organized Oklahoma-Kansas division of the Sunray Oil Company. His headquarters will be in Oklahoma City. Formerly he was assistant general production superintendent.

C. W. DeLANCEY, assistant division superintendent of the Gulf Coast Division, Humble Oil and Refining Company, Houston, Texas, who has been in Europe, returned recently.

RALPH E. DAMP, Ponca City, Oklahoma, assistant superintendent of the northern division of the Carter Oil Company, has been transferred to Illinois as superintendent of production in that area.

J. H. LOUDON, Los Angeles, California, assistant to the vice-president, Shell Oil Company, has been called to The Hague. He is to be assigned to one of the Royal Dutch Shell group's companies, possibly in South America.

ARTHUR B. ALLYNE, chemist with the Southern Counties Gas Company, Los Angeles, California, for the last ten years, has been appointed associate engineer with the California Railroad Commission. **N. K. SENATOROFF** succeeds Allyne with the Southern Counties Gas Company.

PAUL SMITH, production superintendent in West Texas for the Shell Petroleum Corporation, having his headquarters at Odessa, has been transferred to McCamey and will be in charge of the company's operations in Pecos and Upton counties.

C. P. BOWIE, supervising engineer of the San Francisco office of the Oil and Gas Division of the United States Bureau of Mines, recently returned to his headquarters following a trip through the Mid-Continent and Gulf Coast oil fields, where the Bureau is conducting studies on various production problems.

R. L. MITCHELL, assistant superintendent of the Empire's gasoline plant at Konawa, Oklahoma, has been promoted to superintendent to succeed **P. J. PHILLIPS** who resigned to accept an instructor's position in vocational training, sponsored by Oklahoma A. & M. College.

E. R. ESTUS, superintendent of the James gasoline plant at Seminole, Oklahoma, for the Empire Companies, has been made supervisor of safety in the gasoline-motor-transportation-chemical departments. **W. H. TILLOCK,** who has been superintendent of the company's gasoline plant at Asher, Oklahoma, succeeds him. **C. E. POWELL** takes charge of the Asher plant.

THE MASTER

Baldwin's New Chain

No. 1244 S S
185,000 LBS.

The Baldwin Master No. 1244 SS is an entirely new rotary drilling chain. It is engineered by Baldwin to easily meet present day, deep well drilling conditions with an eye to tomorrow's need.

A minimum ultimate tensile strength of 185,000 pounds is guaranteed—this is the whole story in a nutshell.

READ THESE CONSTRUCTION DETAILS

SIDE BARS: Drop forged of alloy steel, heat treated for toughness. Holes accurately broached to size and pitch.

PINS: Forged of alloy steel with upset heads, ground to size and keyed to outside side bars to prevent rotation.

ROLLERS: Of seamless steel, accurately machined, ground to size and heat-treated for toughness.

BUSHINGS: Heat-treated alloy steel, ground to exact size, internally and externally. Keyed to inside side bars to prevent rotation.

COTTERS: High carbon heat-treated steel. Baldwin patented pin lock type, as used successfully on Baldwin Super Service chain — gives rigidity of riveted chain and easy assembly features of a detachable type chain.

The Baldwin Master is the master *rotary chain of all time*

BALDWIN-DUCKWORTH CHAIN CORPORATION

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Factory Representative: Geo. J. Fix, Dallas, Texas

Export Department: Oil Industries Appliances Co., 39 Cortlandt Street, New York City

BALDWIN *Ask the Driller ..HE KNOWS*

LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

The hard-boiled sergeant was not having an easy time in training his squad of rookies.

"Companee—Attenshun!"

"Companee—Lift left leg and hold it straight out in front of you! Posishun!"

One confused rookie raised his right leg, bringing it up next to his neighbors' left leg.

The drill sergeant bawled out:

"Aw right! Aw right! Who's the wise guy that's holding up both legs?"

A London coroner is telling the story of a death certificate which reached him recently. In the column reserved for "cause of death" the doctor had signed his own name. The coroner returned the certificate with a note which said: "This may be true, but don't you think we had better have some scientific reason as well?"

—*Weekly News* (Auckland, N. Z.)

A soldier was on sentry for the first time. A dark form approached him.

"Halt!" he cried in threatening tone. "Who are you?"

"The officer of the day," was the reply.

"Advance!"

The officer advanced, but before he proceeded half a dozen steps the sentinel cried again, "Halt!"

"This is the second time you have halted me," observed the officer. "What are you going to do next?"

"Never you mind. My orders are to call 'Halt' three times and then shoot."

At forty a woman stops patting herself on the back and begins patting herself under the chin.

Lady: I wouldn't cry like that, my little man.

Boy: Cry as you please; this is my way.

A Kansas farmer stopped at a bank to see if he could get a loan on his farm.

"It might be arranged," said the banker. "I'll drive out with you and appraise it."

"You won't need to bother," said the farmer, noticing a huge cloud of dust rolling up the road. "Here it comes now."

"What you need is an electric bath."

"Nothing doing, doc—I had an uncle drown that way up at Sing Sing."

Lawyer for Defense: What time was it when you were robbed?

Complainant (angrily): I don't know; ask your client—he took my watch!"

"Fred! There's someone creeping up the stairs."

"Whazza time?"

"Half past three."

"Well, thank goodness, it's not me this time."

Doctor: And there's really nothing to worry about that habit of yours of talking to yourself.

Patient: Perhaps not, but I'm such a damned bore.

—*Bridgeport Bulletin.*

"So you deceived your husband," said the judge gravely.

"On the contrary he deceived me. He said he was going out of town and he didn't."

When a politician makes his bed, he should lie on it. Unfortunately, however, he seems more inclined to make up his bunk and lie out of it.

—*The Yellow Strand*

Diner: Here, waiter, I found a needle in my soup!"

Waiter (picking up menu): "Beg pardon, sir, that is a typographical error, it should have been noodle."

Mrs. Glanaghan: Was your old man in comfortable circumstances when he died?

Mrs. Murphy: No; 'e was 'alfway under a train.

She: Am I the first girl you ever kissed?

He: Well, now that you mention it, you do look familiar.

"I'm losing my punch," she said, as she left the cocktail party in a hurry.

—*The Hercules Record.*

"To what do you attribute your great age?" asked the city visitor of Grandpa Eben Hoskins.

"I can't say yit," answered Grandpa cautiously. "They's several of them testimonial fellers a-dickerin' with me."

"Oh, Mr. Butcher, about that joint you sold me last week. Did you say it was imported or deported from Australia?"

Father (to young son sucking his thumb): Hey, boy, don't bite that thumb off; you may need it when you get old enough to travel.

An evangelist, after a long exhortation, demanded that all members of the congregation who wanted to go to heaven should stand up. All rose except one man.

"What!" cried the evangelist. "Don't you want to go to heaven?"

"Not immediately," he replied.

A group of Negroes were lying on the floor in front of the fireplace, when one of them spoke up:

"Is it a-rainin' out?"

"Ah don't know," replied another.

"Well, git up an' look," insisted the first voice.

"Aw, hell," said the persecuted one, lazily, "call de dawg in an' see if he's wet."

The Dionne Influence

"How's the wife, George?"

"Not so well, old boy. She's just had quinsy."

"Gosh! How many is that you've got now?" —*Montreal Star.*

An old-fashioned girl who believes in safety first is the one who takes her cigarette out of her mouth before pulling her night-gown on over her head.

Aviation Instructor: That concludes the lecture on parachute work for today, gentlemen.

Student Jumper: Just one more question, Mr. Clupp. What if, after you jump, the parachute doesn't open?

Instructor: If it doesn't open? Well —er—a, that's what is known as "jumping to a conclusion."

—*Pure Oil News.*

Every fifth man in the J & L Seamless Tube Department is engaged in inspection . . . your assurance that the product will meet your requirements.

Deepest gas well in East cased with J&L Seamless

Well down 7600'—produces 1,000,000 cubic feet—100 tons of 7-inch O.D. J&L Grade D Casing used

In Western Pennsylvania, a 1,000,000 cubic foot gas well was recently brought in at a depth of approximately 7,600 feet. This is the deepest gas producing well east of the Mississippi River. When cementing is completed, the flow of gas from the well is expected to reach 3,000,000 cubic feet or more.

J & L Seamless Grade D Casing was selected because it has adequate strength to safely and surely meet the severe demands of installation and of bringing in the well. There can be no failure at or near a weld . . . for there are no welds . . . no weak spots. J & L Seamless Casing is perfectly threaded, therefore threads engage correctly after stabbing and the casing can be spun tight without delay or galling of threads.

Distributors in the oil fields carry a full line of Jones & Laughlin Seamless Steel Products . . . casing, tubing, drill pipe and line pipe. They deliver the material you want, *when* and *where* you want it.

Successful drillers use Jones & Laughlin Seamless Products to cut drilling and setting time and for long satisfactory life. Buy J&L Seamless for strength and safety.

Send for J & L Pipe Handbook-OC-3
The J & L Pipe Handbook contains useful data and interesting information on the manufacture of J & L Seamless. Write today, on your business letterhead, for your copy.

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PITTSBURGH, PENNSYLVANIA

J&L PIPE

J&L SEAMLESS
DRILL PIPE · CASING · TUBING · LINE PIPE

MAKERS OF HIGH QUALITY IRON AND STEEL PRODUCTS SINCE 1850

MACHINERY and EQUIPMENT

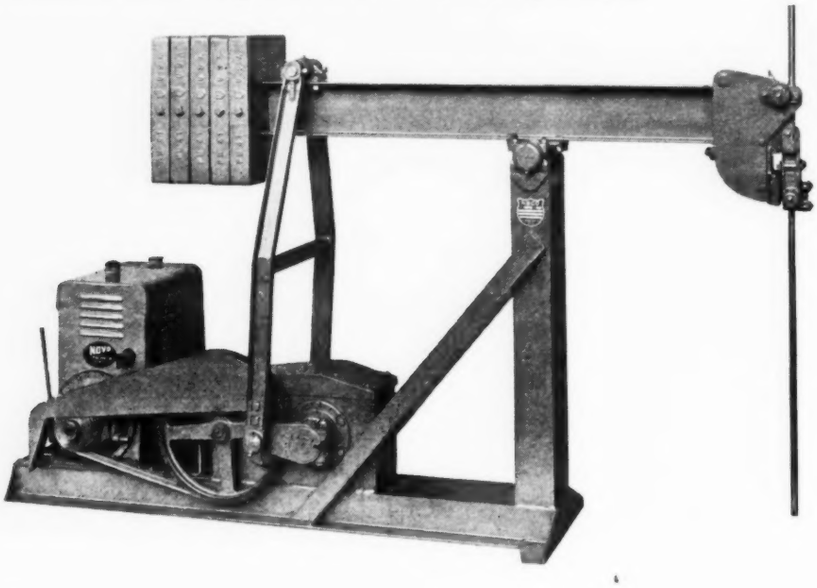
National Unit Pumper for Shallow-Field Single-Well Pumping

A NEW unit for single-well shallow-field pumping is being marketed by the National Supply Company of Delaware, Toledo, Ohio. This is known as the TU7OG-JD7T and is of the self-contained twin-crank design, generally used for heavier pumping duty.

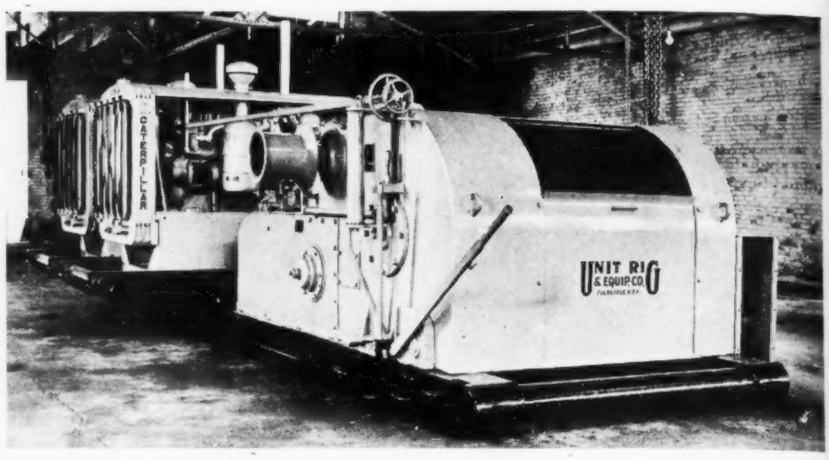
A sufficiently high reduction gear ratio is used to utilize low-cost high-speed prime movers. At the same time further variation in the V-Belt drive allows the adaptation of slow and medium speed types if desired. The cranks clear the derrick floor so that no special foundations are needed and the unit therefore can be economically installed or moved at any time.

All-welded construction is used throughout and the unit is both compact and rigid. The reduction gear is rated at 3.6 nominal hp. at 20 s.p.m. with a reduction ratio of 24.9. The gears are alloy, heat treated, single helical, assuring quietness and efficiency, and run in an oil-tight case. All reduction gear shafts are carried in Timken bearings.

A link-type polished rod hanger that closely approaches straight lift at maximum stroke is regular equipment with arc-type wire-line hanger optional. Well servicing is made convenient by a removable beam hanger head. Saddle, beam, and wrist pin bearings are of the enclosed oil-bath, dust- and oil-tight type. Maximum stroke available is 24 inches. Counterweights are of the beam type added in five increments to give a maximum counterweight effect, at maximum stroke, of 1753 pounds. The weight of the complete unit less the counterweights is 1310 pounds. A bulletin giving complete description is available upon request.



"UNIT RIG"



A WIDE range of drilling speeds and power as a result of flexible speed control is embodied in the "Unit Rig" manufactured by the Unit Rig and Equipment Company, Box 677, Tulsa, Oklahoma. Drilling depths possible with this unit are 2000 ft. to 6500 ft., depending upon the size of the engines.

Power is provided either by one or two engines aggregating 400 hp. or less. The recommended pump size is 7¼ by 14. The rotary drive has three speeds controlled by friction clutch. The drum is of reinforced steel construction. Brake flanges are of heat-treated chrome-moly steel and are demountable. The 5¾-in. shaft is made of selected alloy and is mounted on SKF self-aligning roller bearings. Flanges are 40 in. in diameter and 10 in. wide. The drum barrel is 16 in. in diameter and 39 in. between flanges. A capacity for 7200 ft. of ¾-in. cable is provided.

The case or frame consists of heavy reinforced steel plate, electrically welded. The chain transmission has four forward and two reverse speeds scientifically arranged. By means of friction clutches maximum speed and power efficiency are assured, according to the manufacturers. With only one control lever the operator may shift from low to high speed and vice versa under full load with no change in engine speed. All forward and reverse speeds are available to drum, cathead, and rotary table drive. All chains in the transmission run in oil.

Brakes are 95 percent full-wrap, self-energizing, and fully equalized. Roller chains are used throughout, running on cut alloy demountable and heat-treated sprockets.

All moving parts of the unit are either running in oil or are Alemited from easily accessible positions.

These are the keys to the sweetest music any production superintendent may hope to hear — the music of steady, uninterrupted pumping.

Axelson liners help make harmonious the sour notes of fluid slippage and frequent "pulling jobs." Their established physical strength — their varied chemical characteristics, and their uniform precision finish are reasons why oil men recognize in Axelson deep well plunger pumps: that — "there is no economical substitute for quality."

AXELSON liners are available in hardened cast iron, nitri-cast-iron, super-service hardened steel, and in standard cast iron of sizes and types to fit exacting pumping requirements.

AXELSON

Axelson Manufacturing Company, P. O. Box 98, Vernon Station, Los Angeles • St. Louis • 50 Church Street, New York • Tulsa
Mid-Continent and Eastern Distributor: Frick-Reid Supply Corporation • *Rocky Mountain Distributor:* Great Northern Tool & Supply Company

DEEP WELL PLUNGER PUMPS • SUCKER RODS

Pacific Plunger Pumps Go Streamline

TO increase the flow and volume of fluid through the tubes and mechanism, the principle of streamlining to minimize friction and increase speed has been adopted by Pacific Pump Works, in the internal construction of Pacific "Oil States" Insert Liner Pumps.

Streamline, tapered, and bevelled shoulders minimize obstructions, lift oil without turbulence and cross currents, eliminate "cutting" and emulsions, the manufacturers state. Pacific Streamline pumps meet the requirements of viscosity and temperatures with greater ease, greater recovery, and greater constancy, it is claimed.

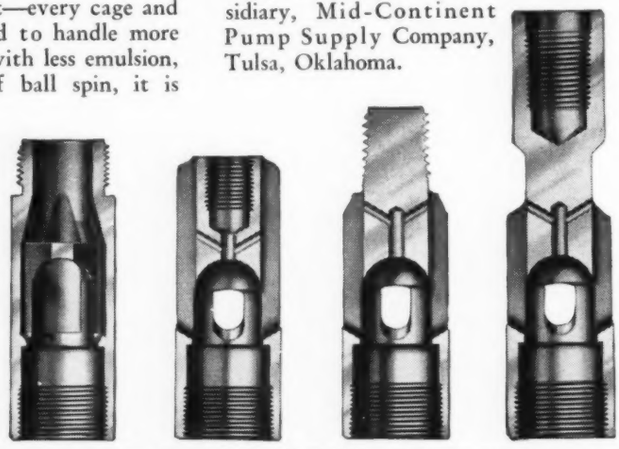
The accompanying illustrations show how every part—every cage and fitting — is enabled to handle more fluid with less hp., with less emulsion, and prevention of ball spin, it is pointed out.

From the shallow depths to the deepest wells, Pacific "Oil States" Insert Liner Pumps meet every pumping condition efficiently and economically, its makers say.

The pumps, obtainable in several sizes, are equipped with plungers and liners to meet fluid and operating conditions.

Moloy liners require less power; add life to deep-well oil pumps; withstand the most severe conditions of sand, high pressure, abrasion, corrosion, and temperature, the manufacturers state. Moloy metal permits close tolerance. Anti-friction qualities and extreme toughness due to special alloying give Moloy metal a sorbitic texture of supreme wearing resistance and high tensile strength — permit "metal-to-metal" contact without sticking or galling, it is stated.

In the Mid-Continent area, Pacific Pump Works operates through its subsidiary, Mid-Continent Pump Supply Company, Tulsa, Oklahoma.



Adds Line of Rings and Valves

THE Industrial Engineering Service, Tulsa, Oklahoma, has equipped a shop and are carrying a complete stock of Insurok for making valves, rings, and rod packing for reciprocating fluid pumps, air compressors, and gas compressors.

Insurok is a laminated plastic, commonly described as Bakelite. This class of material long has been used for valves and rings in pumps, compressors, etc., handling non-lubricating materials. In addition to the standard recognized and accepted type of bakelite the Industrial Engineering Service is equipped and stocked to give immediate service on three very special types of material, it is stated.

The new graphite-impregnated material has proved its value for all services where the lubrication of a bearing, ring or rod is difficult or impossible, officials of the company state. It is particularly well suited for stabilizer feed pumps, gasoline reflux pumps, propane gas compressors, etc. Like standard plastics this grade of material will stand a temperature of only 300 deg. fahrenheit. It has the very decided feature of not scoring liners or rods.

A second new type that has been developed is a grade of material that will stand caustic solutions.

The third special material is a laminated asbestos base material that will stand a temperature of 500 deg. fahr. working temperature. This material has been found to have unusually long life when used for boiler feed pumps, hot absorption oil, hot gas oil, etc., where formerly only metal rings could be used, it is stated. Another application has been found in gas compressors. Many operators have had the experience of having excellent service with bakelite rings, except in special cases where this same material did not stand up at all. It has been found that in many places where the compression ratio is high that the wall temperature of the compression cylinder greatly exceeds the temperature of the gas. This is particularly true where the compressors have been in use for long periods and incrustation from the jacket water has accumulated. In such cases the high temperature material has solved the problem, it is claimed.

Rustless Bull Plugs and Swaged Nipples

W. C. Norris, Manufacturer, Inc., Tulsa, Oklahoma, announces that all bull plugs and swage nipples now coming through the factory are finished by a special electro plating process they call "Norrisizing."

It is claimed that fittings so treated are impervious to corrosion, that the

appearance of the "Norrisized" swaged nipples and bull plugs remains bright and new throughout their useful life, and that the cost of these "Norrisized" fittings is no more than that of the conventional painted articles.

All Norris swage nipples and bull plugs are made from new seamless pipe with size, weight, and threads per inch labeled on each fitting.

"THE CONTINUOUS TABLES"

A feature of features

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THE *Petroleum* Engineer

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KEEP YOUR FILE COMPLETE BY RENEWING YOUR SUBSCRIPTION PROMPTLY

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THE PETROLEUM ENGINEER

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NOW IS THE TIME *to double check your cleaning*

NOW, when you are scrutinizing the year's developments in new, better methods and machinery ... don't forget your cleaning! Here, for instance, are a few jobs where Oakite materials and methods provide the quickest, most thorough cleaning results.

Absorbers	Tank Cars
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OAKITE

SPECIALIZED INDUSTRIAL CLEANING MATERIALS & METHODS

You Need Their PROVED EFFECTIVE PERFORMANCE

The CLEVELAND "MODEL 110"

Digs Anywhere — Any Time

The Cleveland "Model 110" meets squarely all your requirements for pipe line trench.

Maximum usability and uninterrupted performance are the characteristics you have a right to expect and demand of a ditching machine. The compactness, mobility and power built into the "Cleveland 110" assures you of this type of performance.

71" in over-all width, minimum clearance is simultaneously provided at both sides of the machine. Digging widths range from 10½" to 23½". Digs 5' 6" in depth. Thus it is usable for both small and large diameter pipe.

Experience has proved that its design and quality construction provide maximum utility, minimum operating costs and widest application to pipe line work. Write for details immediately.

THE CLEVELAND TRENCHER CO.

20100 St. Clair Ave. Cleveland, Ohio

One Important Cleveland idea that increases value. High-speed, low-cost transportation via special trailer. Load or unload in 10 to 15 minutes. Machine-savings made available even on scattered short lines. "Hot-spots," reconditioning, etc.

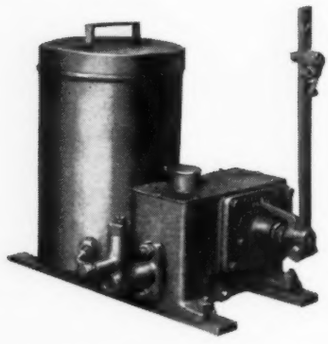
CLEVELANDS

McCord

• CLASS SF MECHANICAL LUBRICATORS •

The design and workmanship of the "SP" for slush pump and drilling engines is of the highest type. The "SP" lubricator will stand up under the most severe conditions of service. Features are—removable pump units and extremely flexible oil delivery—extra large and clear blinker sight feeds—large capacity reservoir—handles the heavy grades of oil.

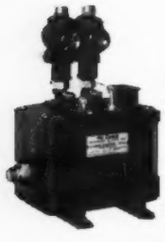
• TYPE C CHEMICAL MEASURING PUMP •



McCord offers an extremely accurate measuring pump for delivering metered quantites of chemicals or liquids. A finely engineered design with a minimum number of parts carefully built to McCord standards insures accuracy.

Features are: Will deliver a predetermined amount of liquid over a definite period of time, or a measured quantity according to the speed of the machine . . . removable pump units . . . working parts enclosed . . . positive delivery against pressures as high as 2,000 pounds.

• CLASS SP MECHANICAL LUBRICATORS •



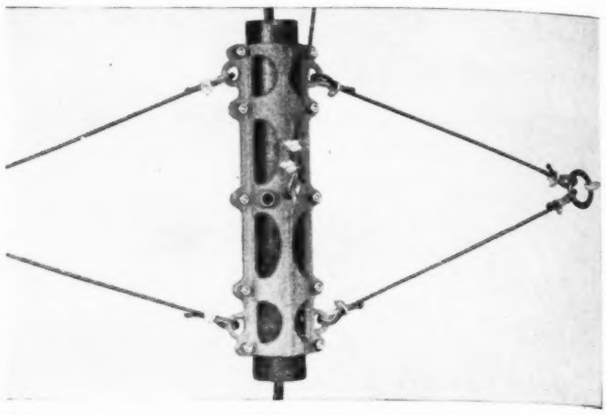
McCord "SF" Lubricators are recommended for air compressor and general lubrication needs where positive oil delivery is desired. Features are: Delivers oil at regular intervals, in a predetermined charge . . . Pump units are sturdy, accurate and positive in operation . . . Any pump unit may be removed without stopping the lubricator . . . Eighteen types of drive are available on the Class "SF".

FOR SALE BY
NATIONAL SUPPLY CO. ALL BRANCHES
McCORD RADIATOR & MFG. CO.
DETROIT, MICHIGAN

STANDARD OF THE OIL FIELDS

Wire Line Guide

"NO sparks" is an important feature of the new improved Patterson-Ballagh Wire Line Guide, manufactured by the Patterson-Ballagh Corporation, Los Angeles, California. Utilizing the same tough rubber at points of friction as used in the manufacture of Patterson-Ballagh protectors, the guide is made spark-proof no matter how fast the line travels or in what position the guide is set, its makers state.



This product permits uniform spooling of the wire line, eliminates whipping, and increases the life of the line, it is said. It easily can be installed in the derrick. It consist of a tough rubber retaining sleeve through which the wire line runs and is housed in a strong metal body, held in taut position by side lines. Replacements can be made without lowering the guide or disturbing line.

To permit an absolutely safe and convenient method of spraying mud, Patterson-Ballagh Corporation introduces its improved safety mud gun. Instead of the conventional method of turning on threads to produce a "swiveling effect," the Patterson-Ballagh safety mud gun has packed joints that preclude the dangerous and expensive blow-offs.

Its facility in turning in any universal direction is an important feature of this mud gun. The one man necessary to operate it can swing the gun back and forth, or up and down, then lock it in position.

The double swivels turn on packing glands, assuring leakproof joints that will rotate easily, it is stated. A 2-in. pipe, thread, inlet, and discharge are used. By substituting the P-B lifetime rubber nozzle for the regular swaged nipple, a superior jet effect is produced and cutting out is eliminated. These nozzles are lined with the same tough rubber as used in the manufacture of the Patterson-Ballagh protectors.

Hercules Announces 4-Cylinder Diesel Series

AS a further step in its program to make available a complete line of high-speed Diesel engines, paralleling in performance and installation dimensions Hercules gasoline engines of similar displacement, Hercules Motors Corporation, Canton, Ohio, has announced the series "DOO" 4-cylinder Diesels.

Of neat, compact design, the new "DOO" series has been developed particularly for use in commercial vehicles of smaller and more popular sizes, as well as for a wide variety of industrial, agricultural, oil field, and marine applications. Three, models of the new series have been produced. The smallest, the "DOOB" has a bore of 3¾ in. and a stroke of 4½ in. and a total piston displacement of 198.8 cu. inches. The "DOOC" has a bore of 4 in. and a 4½-in. stroke with

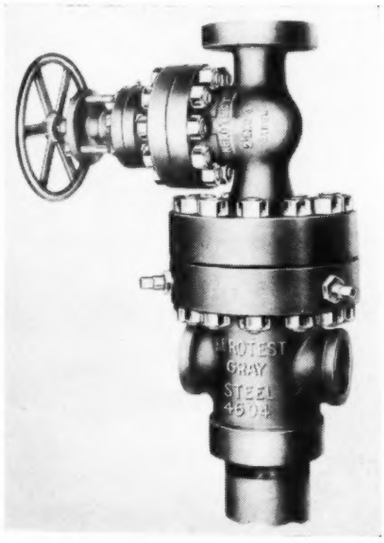
226.2 cu. in. displacement and the "DOOD" has a 4¼-in. bore and a 4½-in. stroke with 225 cu. in. displacement.

The "DOOB" is rated at 62 hp. and the "DOOC" at 70 hp. at an engine speed of 2600 revolutions per minute. At 1600 r.p.m. the "DOOD" develops 56.5 horsepower.

Engines of the new series are interchangeable from an installation standpoint with the extensively used Hercules "OO" series of gasoline engines, allowing manufacturers to supply either gasoline or Diesel engines in their equipment without any mounting complications.

In general design the "DOO" series follows the principles employed in the larger model engines. The patented auxiliary combustion chamber, designed to insure complete combustion and control of fuel consumption, assures smooth, powerful, flexible, and economical performance. This precombustion chamber, an entirely American development, designed and patented by Hercules, is situated at the side of the cylinder bore. The "throat" that connects the cylinder with the chamber is so designed that the piston, on its approach to top center on the compression stroke, gradually reduces the throat area, thus automatically increasing the velocity of air entering this chamber at the time fuel is injected, insuring very thorough mixing of fuel and air.

Kerotest Flow Line Valves, Type G



DESIGNED and built for 10,000-lb. test pressure or 5000-lb. working pressure, the new Kerotest Type "G" line of valves represents an outstanding advance in high-pressure valve design and construction, its makers state.

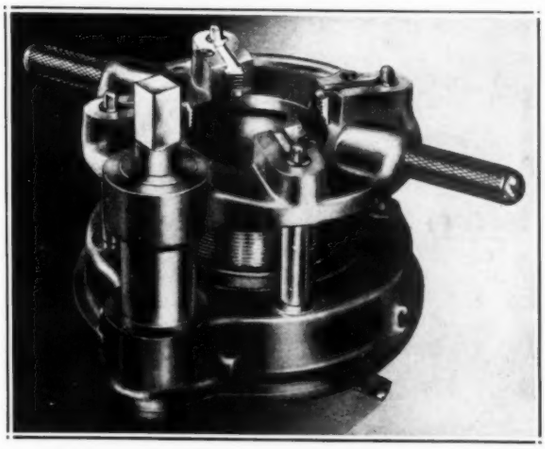
Every part entering into the construction of this new line of valves has been thoroughly tried and proved and amply large factors of safety have been provided. All castings are made of heat-treated manganese molybdenum steel having a minimum tensile strength of 100,000 pounds. The stems are heat-treated nickel steel forgings and extra-large high-tensile bolting is used throughout.

Kerotest 10,000-lb. test Type "G" valves also are available with unequal flanges for direct attachment to Gray Series 1500 design tubingheads, affording a most compact, efficient, and economical method of handling the tubing flow in high-pressure wells.

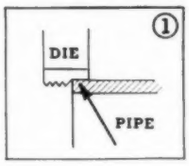
The lower flange, for attachment to the tubing head, is always size 6 in.—Series 1500 ASA—Standard 15½-in. diameter by 3½-in. thick. The top flange is ASA Series 1500 Standard of the same size as the valve employed.

Kerotest Manufacturing Company, Pittsburgh, Pennsylvania, will provide additional information upon request.

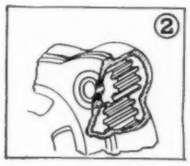
The New Beaver-"48-R"



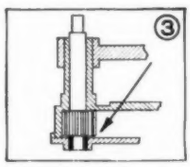
2½" to 4" — 4 Sets of Dies — Fully Enclosed Gears With Five Important Improvements!



1. Extra wide die —with wide throat centers and holds tool in position when placed on pipe.

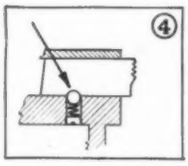


2. Fully-enclosed gears; save costly repair bills!

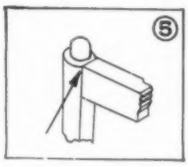


3. Straddle-mounted pinion; an exclusive Beaver advantage, eliminates repairs.

4. Dies held in position by a fully-enclosed dirt-proof spring-backed ball.



5. Shoulder on posts for quick, accurate die setting even under poor light.



Semi-Adjustable
Weigh 58 Pounds
Price, $50.00

Through Your Jobber

BEAVER PIPE TOOLS

1137 PETROL AVENUE WARREN, OHIO

Barnes Rock Bit

MANY outstanding features are claimed for the Barnes Rock Bit by its manufacturers. All parts of the bit, with the exception of the shank, are machined out of solid bar, high-grade nickel steel. The shank is of one piece, cast-steel construction.

The design of the bit is such that positive bottom-hole circulation is maintained at all times during operation, it is stated. Three-way circulation is maintained over the cross-sectional cutters, 2-way circulation over each side cutter, and 2-way circulation through the plate itself. According to E. B. Yeargan this feature assures smooth running and free cutting at all times without any possibility of running over old cuttings. It is seldom necessary to raise and lower the bit in the hole to flush out the cutters.

All cutters are pack-hardened and carry a ⅛-in. case. They are hard-faced with Haystellite, but other approved hard facings will be applied if specified. Bearings for the cutters are of the roller type, heat treated and finished in the Barnes plant.

Authorized distributors are now being appointed in all principal oil fields. For further information, write the Barnes Bit Sales Company, 8668 Otis Street, Southgate, California.

Specify Spang

"HIGHER-STANDARD" CABLE TOOLS

and DRILL

WITHOUT DELAY!

Fig. 516

STEM PIN (Heat-Treated)

Fig. 517

STEM BOX (Heat-Treated)

Delays in cable-tool drilling are frequently caused by the failure of mismatched joints. Specify Spang for the entire string and you'll avoid costly shutdowns. They'll drill more footage and outlast any ordinary "mixture" of tools, because they're strictly "Higher-Standard" Cable Tools.

Consult SPANG about any cable-tool problem that arises.

The HIGHER STANDARD

SPANG & COMPANY, BUTLER, PA.

Martin-Decker Unitized Mud Pump Gauge

MARTIN-DECKER Corporation, Long Beach, California, has developed a new Unitized Mud Pump Gauge that the manufacturers claim is the most rugged instrument ever built for measuring slush pump pressures. It is strong and compact, and it is completely engineered to give smooth, accurate readings of slush pump pressures under all conditions. It is unaffected by rapidly surging pressures or

by circulating fluids, and its mechanism is especially constructed to withstand the extreme vibration of the slush pump, it is stated. It contains all the features of the well-known Martin-Decker Individual Mud Pump Gauge, but does not require the use of tubing or fittings to connect it. In fact, it is as easy and quick to install as a bull plug or swaged nipple, and just as easily moved from rig to rig.

The new gauge embodies a patented diaphragm unit, a patented pulsation damper, and the latest type indicator gauge, all unitized into one compact case. The diaphragm unit is built and tested for a 5000-lb. working pressure, and by means of a flexible separator completely seals the mud out of the gauge mechanism. The gauge and damper system is filled with a non-corrosive, non-freezing fluid that assures accurate pressure readings under all conditions and gives complete protection to the gauge mechanism. The built-in pulsation damper has an infinite range of adjustments that give smooth readings unaffected by pressure

surges, yet allow instant sensitivity to actual pressure changes. This element not only assures complete readability of the gauge hand at all times, but also protects the gauge mechanism from the destructive wear and tear of constantly pulsating pressures, it is pointed out.

The indicating gauge is of the vernier retard type recently developed by Martin-Decker, and combines both extreme sensitivity and high capacity in the one unit.

Jeffrey Mud Screen

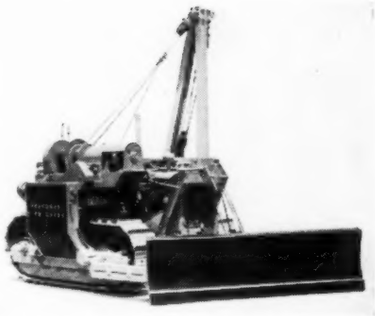
A NEW screen for the conditioning of rotary drill mud is announced under the trade name Blue Streak shale shaker by the Jeffrey Manufacturing Company, Columbus, Ohio. This unit carries a 4 ft. by 6 ft. screen and is of rigid, self-contained construction. Its spring action differs from that of any other similar purpose unit, the

manufacturers state, the reject end being supported by patented leaf-spring legs that give a lively screening and conveying action. Amplitude of vibration may be adjusted while the screen is running, by changing the tension of springs on the feed end. Sagging and whipping of the screen cloth is prevented by ample lengthwise and crosswise supports, and the screen cloth is tautly stretched both ways.

The vibrating unit is an unbalanced pulley on roller bearings on a stationary shaft that is rigidly attached to the screen frame. These bearings run in an oil bath inside a sealed housing and consequently require no attention for long intervals. Centrifugal force distributes oil over the entire bearing surface.

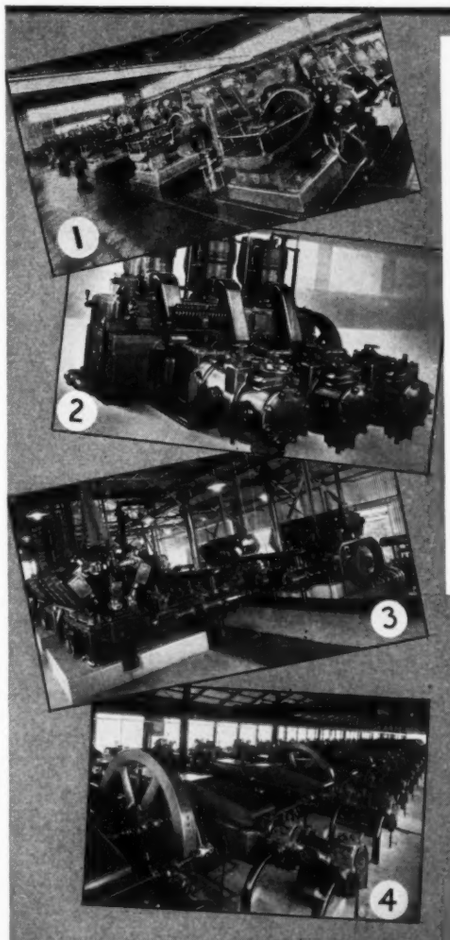
Trackson Anglefiller

A NEW angle blade is now available for Trackson pipe layers mounted on "Caterpillar" tractors "Thirty" and RD4. The combination units are especially useful on reconditioning and repair work, as well as on short-line construction, building gathering lines, and laying short loops or laterals. Anglefilling the trench insures



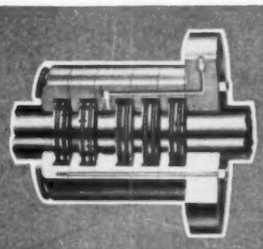
a uniform compact fill due to the tamping action of the tractor tread, thus reducing liability to line damage from undercuts and washouts, the makers state. The angle blade is easily adjustable for bulldozing dirt straight ahead or at an angle of 30 deg. to either side, cutting a path with ample overlap beyond the outside edges of the tracks. Raising and lowering of the blade is controlled by a single lever, and a safety throwout prevents damage from overrun in raising. When not in use, the blade may be secured in the raised position or the complete assembly quickly and easily removed. Full particulars may be had by writing Trackson Company, Milwaukee, Wisconsin.

Seal your reciprocating piston rods
the way so many engine and compressor operators do... with
COOK'S METALLIC PACKINGS



Wherever you may look throughout the oil and gas fields you will find COOK'S Metallic Packings predominating on the power and compressor rods of gas pumping and gasoline extraction engines. Noteworthy applications are represented by the engines, shown in the accompanying illustrations, that come factory equipped with COOK'S modern Packings.

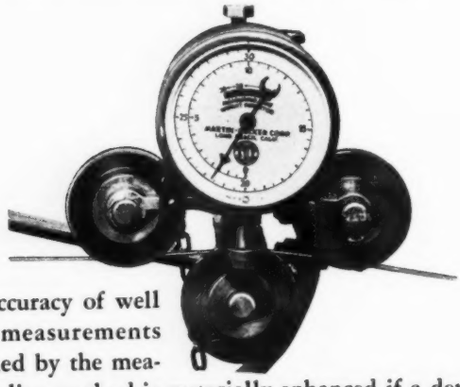
Make sure you get the genuine COOK'S Packings when buying new equipment by specifying their use. For existing equipment communicate with us direct, or our nearest branch office.



1-COOPER-BESSEMER CORP.
2-CLARK BROTHERS COMPANY
3-INGERSOLL-RAND COMPANY
4-WORTHINGTON P&M CORP.

C. LEE COOK
MANUFACTURING CO.
INCORPORATED
LOUISVILLE, KY.
NEW YORK • LOS ANGELES • CHICAGO
NEW ORLEANS • CLEVELAND • TULSA
BALTIMORE • SAN FRANCISCO

WELL DEPTH MEASUREMENTS

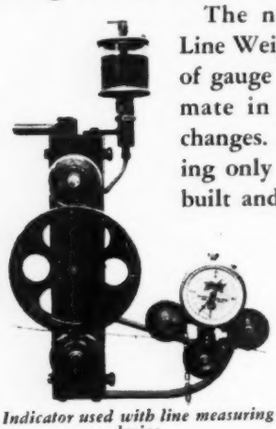


The accuracy of well depth measurements obtained by the measuring line method is materially enhanced if a dependable Measuring Line Weight Indicator is used during the Measuring operation.

A "check up" between the drill pipe measurements and the measuring line method can only be made when the absolute "pick up" of the "sinker" is ascertained. "Pick-up" can be ascertained accurately only with a Weight Indicator.

The Martin-Decker Measuring Line Weight Indicator shows continuously the exact tension load on the line regardless of whether the line is moving or at rest. It assures *precision* readings, while bumping bottom, slacking off or bouncing the line can never result in more than approximate readings.

Besides measuring jobs the Martin-Decker Measuring Line Weight Indicator boosts the safety and efficiency of running pressure bombs, survey instruments, etc. It prevents kinking and piling up of the line while going into the hole and eliminates risk of over-straining the line and losing valuable instruments when coming out.



Indicator used with line measuring device.

The new Martin-Decker Measuring Line Weight Indicator has a Vernier type of gauge mechanism that assures the ultimate in sensitivity to small weight changes. It is light and compact, weighing only 6¾ pounds, but it is ruggedly built and very easy to install. It will accomodate all sizes and cables up to and including 3/16".

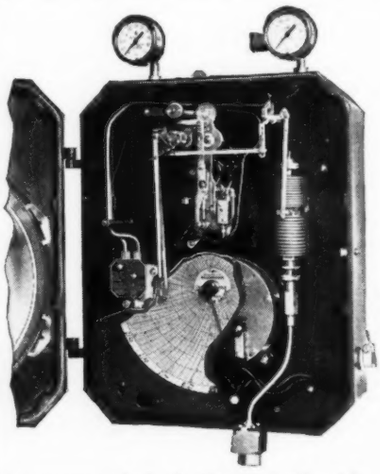
We will be glad to mail you a copy of the descriptive literature.

THE WEIGHT INDICATOR
MARTIN DECKER CORP.
LONG BEACH CALIFORNIA

San Joaquin Valley: A. F. McQUISTON, Bakersfield, California
Mid-Continent Distributor: REED ROLLER BIT COMPANY, Houston, Texas

Taylor's Absolute-Pressure Instruments

THE critical relationship that exists between absolute pressure and the physical properties of gases and vapors under low pressure is too frequently ignored. Unless fluctuations in barometric pressure are considered, errors in measurement and serious variations in processing may result from the apparently negligible discrepancy. Advanced engineering practice specifies the absolute-pressure system for low-pressure measurement.



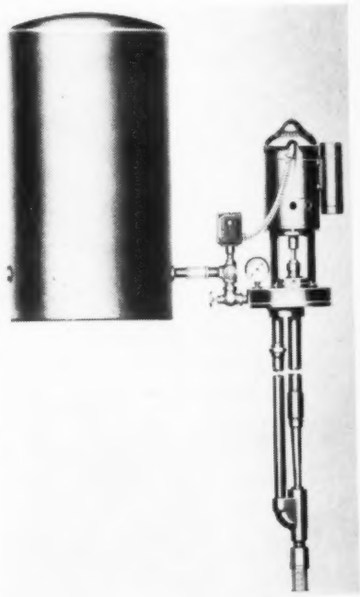
Complying with this technological advancement, the Taylor Instrument Companies, Rochester, New York, have announced a new line of instruments for indicating, recording, and controlling absolute pressure.

The absolute pressure element consists of a flexible phosphor-bronze bellows to the inside of which the pressure medium under measurement is communicated. Connected with this assembly, and opposing its action, is a second identical metal bellows that has been evacuated and sealed, thus comprising an atmospheric-pressure compensator.

These instruments are applicable to distillation units, evaporators, condensers, and in general, wherever the corresponding mercury type of gauges can be used—with the exception, of course, of gases or vapors corrosive to the bronze bellows.

Fairbanks-Morse Duplex Power Pumps

FAIRBANKS, MORSE AND COMPANY, Chicago, Illinois, have developed a new line of duplex power pumps, described in Bulletin 6130, for oil field service, fire protection, and general service requiring pressures up to 800 lb. per sq. in. and capacities to 187 gal. per minute.



Among the features of this new F-M Fig. 6130 power pump are quiet, efficient herringbone gears that insure a smooth flow of power to the fluid end, with a minimum of vibration, generous crankshaft and pinion-shaft roller bearings that reduce mechanical friction to a minimum, and an improved line type fluid end, the manufacturers state.

Because of their positive displacement design and operating principle, power pumps are more suitable than other types for certain conditions and require-

ments, it is stated. In handling heavy or viscous liquids, the speed of the power pump can be reduced to effectively accommodate slow-flowing characteristics. Cylinders are filled on each piston stroke, and the pump performs at its maximum efficiency.

F-M Fig. 6130 power pumps are offered with a fluid end piston stroke of 10 in. and with cylinder diameters of 2½ in. to 5 in., providing a capacity range of 40 to 187 U. S. gal. per min. at pressures from 250 to 800 lb. per sq. inch.

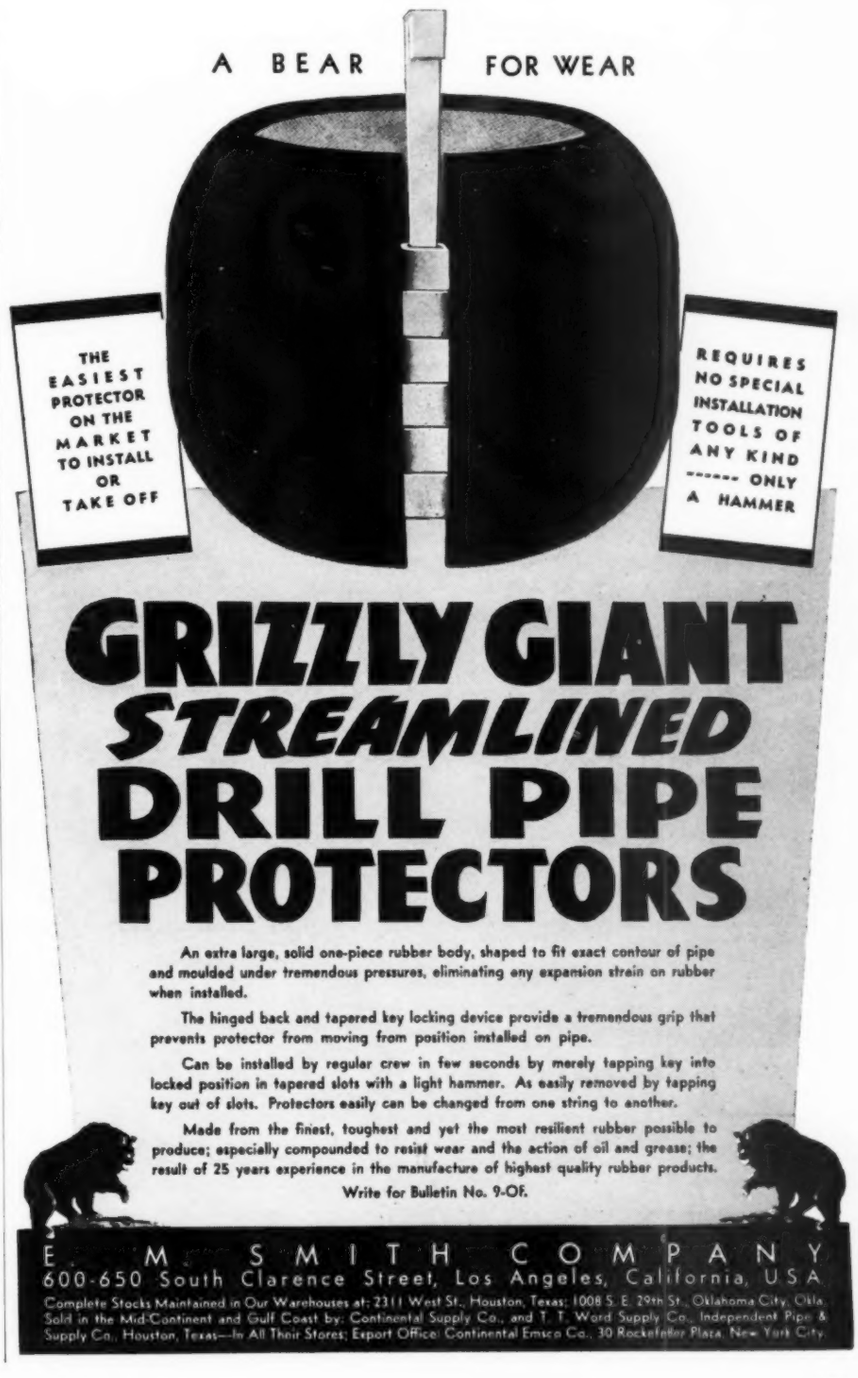
Cable-Tool Bit of Byron Jackson Company

A NEW design has been used in the BJ straight-hole cable-tool bit just placed on the market by Byron Jackson Company, 2105 East Slauson Avenue, Los Angeles, California. Developed for drilling in any type of formation with cable tools, this tool consists of a pilot bit above which is a concentric reamer and stabilizer. The reamer is an integral part of the bit and there are no joints and no expanding or detachable parts. The length of the pilot bit is longer than the normal drilling stroke and insures that the pilot bit always will remain in the pilot hole, thus serving as a positive straight-hole guide, the manufacturers state. The small diameter of the pilot bit permits it to penetrate hard formations, or formations with a steep pitch, with far less danger of deviating from the vertical than when a larger diameter bit is used, it is stated.

The reamer cutters have to break down only the upper edge of the pilot hole as they enlarge the hole to the desired full diameter. It is easier, quicker, and less expensive to drill a large-diameter hole by this method than by using a large-size, conventional-type bit, the makers say.

The reamer cutters act as straight hole stabilizers because they are always out to full-gauge and are situated from six to ten ft. (depending upon size of bit) above the cutting edge of the pilot bit. The pilot bit also remains out to full-gauge and normal wear on both pilot bit and reamer cutters will not result in tight hole being drilled.

The bit is made in nine sizes for holes ranging from 8¼ in. to 24 in. in diameter with the pilot hole from 6 in. to 12 in., respectively. The length of pilot is eight ft. in the 8¼-in. and 10-in. sizes and ten ft. in the sizes from 12½ in. to 24 inches.


A BEAR FOR WEAR
THE EASIEST PROTECTOR ON THE MARKET TO INSTALL OR TAKE OFF
REQUIRES NO SPECIAL INSTALLATION TOOLS OF ANY KIND ------ ONLY A HAMMER
GRIZZLY GIANT
STREAMLINED
DRILL PIPE
PROTECTORS
An extra large, solid one-piece rubber body, shaped to fit exact contour of pipe and moulded under tremendous pressures, eliminating any expansion strain on rubber when installed.
The hinged back and tapered key locking device provide a tremendous grip that prevents protector from moving from position installed on pipe.
Can be installed by regular crew in few seconds by merely tapping key into locked position in tapered slots with a light hammer. As easily removed by tapping key out of slots. Protectors easily can be changed from one string to another.
Made from the finest, toughest and yet the most resilient rubber possible to produce; especially compounded to resist wear and the action of oil and grease; the result of 25 years experience in the manufacture of highest quality rubber products.
Write for Bulletin No. 9-Of.
E. M. SMITH COMPANY
600-650 South Clarence Street, Los Angeles, California, U.S.A.
Complete Stocks Maintained in Our Warehouses at: 2311 West St., Houston, Texas; 1008 S. E. 29th St., Oklahoma City, Okla. Sold in the Mid-Continent and Gulf Coast by: Continental Supply Co., and T. T. Word Supply Co., Independent Pipe & Supply Co., Houston, Texas—In All Their Stores; Export Office: Continental Emsco Co., 30 Rockefeller Plaza, New York City.

Goodrich Burst-Proof Hose

A NEW industrial safeguard in the form of burst-proof steam hose has recently been introduced by The B. F. Goodrich Company, Akron, Ohio. When this hose fails it will leak but nothing can cause it to burst except an external blow severe enough to cut the wire reinforcement, the manufacturers state. It is recommended for 200-lb. working pressure in all sizes, with a safety factor of 15 to 1 in larger diameters and up to 35 to 1 in small diameters.

Tube (A) and insulating layers (C, E) of burst-proof steam hose are made of a special heat-resisting rubber compound.

Burst-proof hose is designed with a reinforcement of high-tensile steel wire (B, D), which, unlike cotton fabric construction, cannot burn out and deteriorate. Wire is applied in a braided form with openings large enough to permit the rubber to rivet itself, thus preventing any possibility of tube collapse. It will be noted that the form of wire tape used consists of seven or eight strands of wire laid side by side. This construction utilizes the maximum strength of the wire so that no additional reinforcement is needed beyond a single ply of wire tape in small sizes and two plies in larger sizes.

Outside of the wire braid and underneath the cover is embedded an additional braid of strong asbestos cord (F). Being a slow conductor of heat, this asbestos layer protects the cover from burning.

Completing the construction is a heavy, long-wearing black rubber cover that is heavily compounded with a special Goodrich anti-oxidant, known as Agerite, to give it unusual age-resisting qualities.

Goodrich burst-proof steam hose is available in sizes ranging from ⅜-in. to 2½-inch.

Hancock Duravalve

THE Hancock Valve Division of Manning, Maxwell & Moore, Inc., Bridgeport, Connecticut, announces a new type of steel valve called the "Hancock Duravalve." The valve has been developed expressly for high-pressure and high-temperature service (1500 lb. at 950 deg. fahr.).

The makers claim that Duravalves with internal Stellite seats put an end to valve maintenance due to steam leaking between the valve seat ring and the valve body. The accompanying illustration shows how the new design permits

the Stellite seat facing to be welded in easily and serviced even on small size valves.

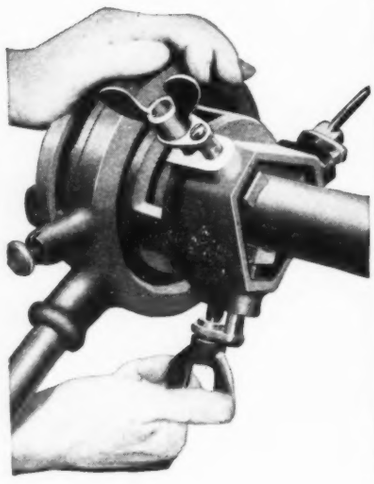
Hancock Duravalves are made in one

THE EASIEST OPEATING—

. . .tool for cutting 1 to 2-in. threads is a "TOLEDO" No. 1BR—because:

1. A separate set of dies for each size pipe gives the proper cutting angle and clearance for each size.
2. Famous "TOLEDO" die receding principle reduces pull.
3. Accurately fitted parts make for smooth, efficient operation.

Specify a "TOLEDO" No. 1BR for better results. Sold by leading Oil Well Supply Dealers.



THE TOLEDO PIPE THREADING MACHINE COMPANY
TOLEDO, OHIO
New York Office, 72 LaFayette Street

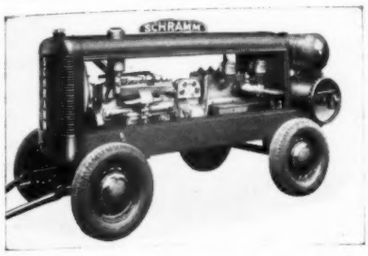
"TOLEDO"
BETTER THREADS

basic size and then tapped, or bored for welding, for ½-in., ¾-in., or 1-in. pipe. The makers state that this simplification will take care of 90 percent of the small valve requirements on any high-pressure power plant job, and that it cuts repair part stocks and maintenance parts by two-thirds.

Illustrated bulletin will be sent on request.

"Utility" Air Compressor Line by Schramm, Inc.

THE accompanying illustration is symbolic of the complete "Utility" Air Compressor line now offered by Schramm, Inc., West Chester, Pennsylvania, in sizes 85, 105, 160, 210, 260, 315, and 420 cu. ft. actual



air delivery in both gasoline and Diesel engine-driven models. Weight savings up to 3500 lb. in the gasoline-powered models and up to 8000 lb. in Diesel-powered machines is an outstanding economy feature of the Schramm "Utility," the makers state.

The straight-in-line cylinder construction is used on all models, together with force-feed lubrication to all seven main bearings. Other features include electric self-starting on all models, self-aligning clutch between compressor unit and motor, mechanical intake valves, discharge valves occupying entire area of head, water-cooled engine and compressor, and special attention given to modern, streamlined finish and all details of construction.

Crane Iron Gas Line Cocks With Recessed Ends

TO supplement its regular line of iron gas line cocks, Crane Company, Chicago, Illinois, has added a new cock with recessed ends for use on curb box installations. This new feature is important when it is considered that these cocks are usually buried in the ground below the frost line, where dirt and grit and moisture make their way around the exposed threads of connecting pipes, thus causing corrosion and the costly and laborious task of digging three or four feet into the ground to repair a leak

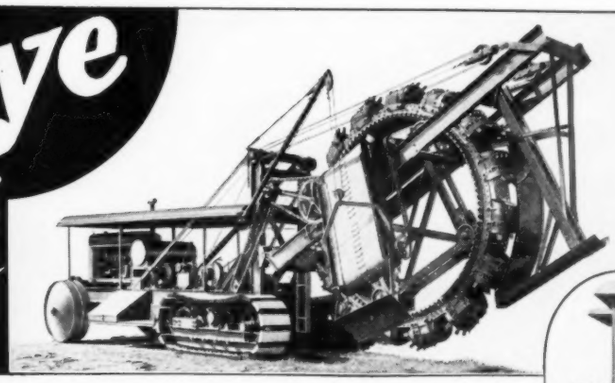
CRANE IRON GAS LINE COCK

in the gas line.

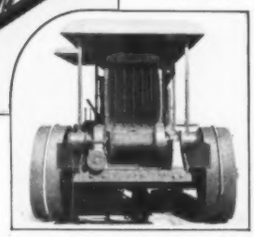
These new cocks are recessed at each end sufficiently to cover the entire threaded pipe surface. When the recesses are filled with a lubricant or paint to seal the space between the pipe and the inside of the cock opening, it protects both the cock and the pipe threads from outside contamination, thereby not only making a perfect connection, but adding years to the life of the installation.

These new cocks are made with flat head, brass plug and washer. Body is of galvanized iron, in sizes ¾ in., 1 in., and 1¼ inch. They are air-tested to assure tightness, and are recommended for non-shock working pressure of 125 lb. cold water, oil, air, or gas.

Buckeye DITCHERS



Model 49 The PIPELINER for all large main line trenches.



Models 11 and 12

Small · Fast · Easily Handled

ORIGINATORS of the WHEEL-TYPE DITCHER

Save you money ON ANY TYPE, SIZE OR LENGTH OF ditching job.

New Modern models for every trench requirement, give you the last word in engineering for speed, accuracy, reliability and final economy.

As originators of the wheel type ditchers and builder of the equipment used on the most important pipe lines the world over, we offer you the experience of a third of a century in pipe line excavation equipment — the kind of experience that results in profits to you.

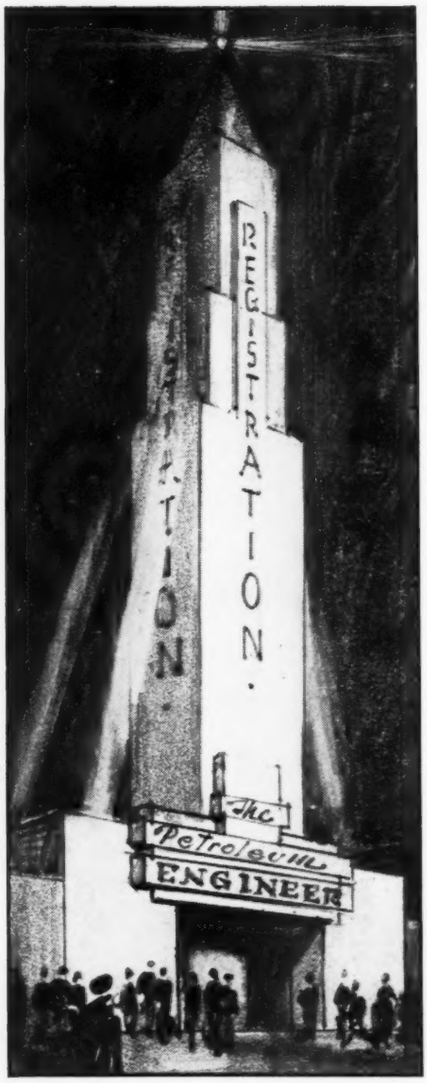
Buckeye ditchers have dug the trench for more miles of pipe line than all other makes of ditchers in the world — and today, more Buckeye Ditchers are in operation than any other ditchers built.

Buckeye has the answer to every ditching problem. It will pay you to consult our engineers before you start any ditching project, large or small.

Write for literature and prices.

THE BUCKEYE TRACTION DITCHER COMPANY
• FINDLAY, OHIO •

Builders of Excavating Equipment for over 1/3 of a Century



Architect's drawing of the proposed registration building *The Petroleum Engineer* plans to erect for the 1938 show

Extensive Building Program in Progress for International Petroleum Exposition

HERALDING the largest International Petroleum Exposition in history, a $250,000 new building program is announced by President W. G. Skelly.

The program includes a tower-type registration building to be constructed by *The Petroleum Engineer;* a new exhibit building containing 128 booths; modernistic brick cafeteria previously announced; new two-story office building; and seven exhibit structures to be built by individual exhibitors. Gas, water, and electric lines will be extended so as to provide ample facilities for all exhibitors.

Work has been started on the two largest units, the new exhibit building, and cafeteria. All buildings will be completed for the May 14 to 21, 1938, show.

The new exhibit building will be just south of the Oklahoma Building, containing 21,800 sq. ft. of floor space. Individual exhibitors putting up buildings, besides *The Petroleum Engineer,* are: W. C. Norris, Manufacturer, Inc., Gaso Pump and Burner Manufacturing Company, International Harvester Company, Oil Well Supply Company, Bovaird Supply Company, and Hinderliter Tool Company.

Double the office space heretofore available will be provided in the new business building. A directors' meeting room and larger lobby for servicing exhibitors will feature the structure.

The new exhibit building will add 25 percent more inside space to the 50 percent greater outside exhibit space that previously was announced.

The appointment and acceptance of Dr. Gustav Egloff to serve as chairman of the Scientific and Technical Committee for the 1938 oil show at Tulsa also is announced by General Manager Wm. B. Way.

Egloff, who is director of research for the Universal Oil Products Company of Chicago, also is a director of the Exposition.

Egloff, Dr. C. K. Francis, petroleum technologist, who is vice-chairman of the committee, and Way met in Chicago recently to perfect plans for the exhibits.

It was decided that a Hall of Science be provided and a building with three times the space used last year will be made available to the committee. The displays may become part of a permanent exhibit of scientific and technical equipment that Exposition officials hope eventually to establish as a part of the plant.

Members of the executive committee serving with Egloff and Francis are: W. A. Schlueter, president of the Refinery Supply Company, Tulsa; Emby Kaye, vice-president, Skelly Oil Company, Tulsa; B. W. Logue, chief chemist, The Texas Company refinery, Tulsa; R. L. Ginter, Ginter Chemical Laboratories, Tulsa; L. S. Gregory, consulting engineer, Tulsa. All of these men have served on previous exposition scientific committees, Schlueter being chairman for many years.

Other members of the executive and general committee will be appointed later.

Indication of a large attendance to match the already assured large number of exhibits, is seen in the number of reservations already sent in for hotel facilities. The Housing Bureau, under the direction of Chairman Earl Sneed, although open but a few weeks, already has handled more than 1000 requests in addition to ones sent direct to the hotels.

Drawing of new exhibit building now under construction

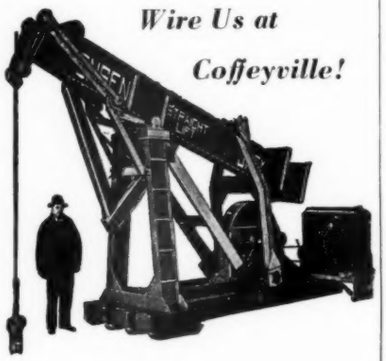
We Have Solved Your PUMPING PROBLEMS!

We have done nothing for 19 years but make and perfect pumping equipment.

We can sell you a JENSEN Straight-Lift JACK that will cut the cost of producing any well. Easy to install and absolutely dependable.

Your JENSEN dealer will gladly tell you what to expect of a JENSEN Straight-Lift JACK on any given well, or we will be glad to have you...

Wire Us at Coffeyville!



JENSEN BROTHERS MANUFACTURING CO.

. . . Coffeyville, Kansas

Renew Your Subscription Promptly

Morgan In Illinois for BJ

The Oil Tool Division of Byron Jackson Company, announces the establishment of a sales and service

O. W. MORGAN, JR.

office at 425 South Fair Street, Olney, Illinois, with O. W. Morgan, Jr., in charge.

Morgan has been connected with Byron Jackson Company for several years in a similar capacity in California, and his knowledge of BJ drilling and production tools will enable him to render prompt and satisfactory service to Illinois operators.

F. C. Schulze Promoted By Waukesha

Appointment of F. C. Schulze to the post of assistant sales manager has been announced by the Waukesha Motor Company, Waukesha, Wisconsin, as a part of their sales department expansion program.

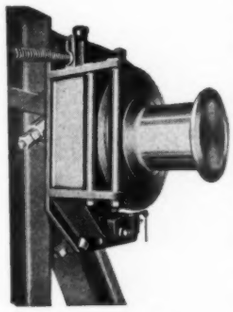
F. C. SCHULZE

This appointment is the culmination of ten years of thorough ground work in most every department of the company. Schulze became associated with Waukesha in 1928, joined the sales department four years ago, and since has been active in sales direction and organization. Besides his inside training, he has spent some time in the field with users of Waukesha engines.

Geared Power Is Smooth Power

When engineers want smooth positive power—power far in excess of the actual needs at hand—they turn to gears for their driving force ... and that's exactly what MacClatchie engineers have done in the Gearomatic Cathead.

Geared two to one, this husky cathead gives DOUBLE the power at HALF the line shaft speed. It breaks the largest, most stubborn tool joints with the smooth ease of a Titan... without jars, without jerks, yet with perfect control.



MacClatchie Gearomatic CATHEAD

And check this — a positive kick-out device permits one revolution — and one only—per pull ... there's no danger of fouled lines injuring workmen or damaging rig equipment when you use the MacClatchie Gearomatic!

Contact your nearest MacClatchie representative for complete information on this modern tool ... it's a money saver!

Made in Three Sizes
The Midget in Sizes Up to 4", the Junior Up to 5½" and the Senior Up to 8½"

MACCLATCHIE MANUFACTURING CO.

Compton, Calif. Houston, Texas

EXPORT:

Geo. R. Woods, 17 Battery Pl., New York

Lincoln Electric Opens Phoenix Office

The Lincoln Electric Company, Cleveland, Ohio, announces the opening of a new sales office in Phoenix, Arizona, in charge of R. J. Reardon.

Reardon has had experience in all branches of welding. For two years he was in charge of the Steel Tank and Manufacturing Company, Detroit. Another two years were spent in the position of welding engineer and sales manager for the C. H. Patterson Company of Hamtramick. In 1929 he became welding supervisor for the Gilbert and Barker Manufacturing Company of West Springfield, Massachusetts, in which position he remained until 1931. For the last six years, Reardon has been with the American Metal Products Company of Detroit as welding engineer and supervisor.

Gaso Announces Pacific Coast Distributor

The Gaso Pump and Burner Manufacturing Company, Tulsa, Oklahoma, makers of oil field, refinery, and pipe line pumps, has announced the appointment of Service Oil Field Supply Company, Los Angeles, California, as Gaso distributors for the Pacific Coast. Headquarters of the Service Oil Field Supply Company are at 5333 Riverside Drive, Los Angeles.

A Mountain in the Desert

A pile of sand like this is a common sight beside West Texas oil wells, where THE CAVINS is in demand for use in cleaning-out after shooting with "nitro". It's oil—all that the well can make—that any operator is after and he can't get his maximum if ordinary clean-out tools have left the producing horizons plastered with contaminating material. With THE CAVINS, he can't miss. The powerful fluid surge, which takes place when THE CAVINS takes its load, washes all recoverable material down to the bottom of the hole for easy recovery, leaving the producing horizon open and free to make its normal production.

You don't have to be located in West Texas, however, to profit from the use of this remarkable tool—rental agencies are established in all strategic fields. Let us send you descriptive literature.

THE CAVINS COMPANY

2853-73 Cherry Avenue • Long Beach, California

Cable Address: "Cavins, Long Beach." *Foreign Representative:* R. J. Eiche

Branches—CALIFORNIA: Bakersfield, Taft, Ventura; TEXAS: Houston, Kilgore, Odessa, Big Spring, Monahans, Pampa; OKLAHOMA: Ada, Oklahoma City, Perry; NEW MEXICO: Lovington; TRINIDAD, B. W. I.

Statement of the Ownership, Management, Etc., of THE PETROLEUM ENGINEER October 1, 1937

(This statment is published in compliance with the Act of August 24, 1912.)

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President and General Manager: Clarence Morris, Dallas, Texas.

Editor: K. C. Sclater, Dallas, Texas.

Stockholders holding 1 per cent or more of total amount of stock: C. R. Barrett, W. T. Bryan, W. L. Love, Clarence Morris, and K. C. Sclater, Dallas, Texas; J. L. Dwyer, T. J. Crowley, and Mrs. J. H. Dameron, of Tulsa, Oklahoma.

Known bondholders, mortgagees and other security holders holding 1 percent or more of the total amount of bonds, mortgages or other securities: Johnston Printing and Advertising Co., Olmsted-Kirk Co., A. Zeese Engraving Co., Jaggars-Chiles-Stovall, Inc., Tower Corporation, F. H. Penn, Texas Power & Light Co., Dallas Clearing House Association, Dallas Gas Co., E. R. Brown, Dallas Power & Light Co., Southwestern Bell Telephone Co., F. R. Schneider, Trustee, F. V. Faulkner, A. Harris & Co., Gulf Insurance Co., Higginbotham-Bailey-Logan Co., Adolphus Hotel, The Schoellkopf Co., Industrial Dallas, Inc., Von Hoffman Press.

W. T. BRYAN, Secretary-Treasurer.

Sworn to and subscribed before me this 29th day of September, 1937.

RANDALL R. WILSON, Notary Public.

(My commission expires June, 1939.)

Link-Belt Transfers Bill Abele

W. H. (Bill) Abele, Link-Belt Company oil field representative covering Oklahoma-Kansas territory and the

W. H. (BILL) ABELE

Texas Panhandle area, has been transferred from Oklahoma City to Tulsa, Oklahoma. Abele's address in Tulsa is 1527 South Atlanta Place.

E. L. Stevens, of Union Wire Rope Corporation, Dies Unexpectedly

Edward L. Stevens, for the past year manager of sales of commercial wire rope for the Union Wire Rope Corporation, of Kansas City, recently died of heart disease. He was 43 years old and apparently in robust health. He is survived by his widow and two children.

Interment was at Tulsa, Oklahoma, where Stevens for many years was associated with the Republic Supply Company.

Barnes Bit Sales Co. New California Firm

One of California's newest oil-field equipment concerns is the Barnes Bit Sales Company, Southgate, formed to handle the sales and service on the Barnes Roller Bearing Bits. Manufacturing and production work for the new company is being done by W. J. and H. C. Barnes, well known to the oil fraternity for many years through their past connection with other bit concerns. Sales and service are under the direction of E. B. Yeargan, T. A. Thomas, and D. H. DeWitt. The sale of Barnes bits in Taft and Bakersfield territories is being handled by the Dennis Welding Company. In Santa Maria J. D. McIlroy of the Fleet Oil Tool Company is in charge of sales and service.

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The Texas State offers the utmost in comfort and modern luxury. Yet rates are well within modest budgets. For instance, complete luncheon is served in our attractive Mezzanine Dining Room for as little as 65c.

HOUSTON'S NEWEST HOTEL

Tub and Shower in all rooms

LOW AS 2.50 A DAY

B. F. ORR, General Manager

RENEW YOUR SUBSCRIPTION PROMPTLY

Schraub Appointed Sales Manager Union Wire Rope Corporation

Lester G. Schraub, for the last nine years manager of sales for the Wire Division of the Sheffield Steel Corporation, Kansas City, has accepted the appointment as general sales manager of the Union Wire Rope Corporation, of Kansas City. His headquarters are at the company's general offices, 21st and Manchester, Kansas City. The Union product is distributed throughout the wire rope using industries of

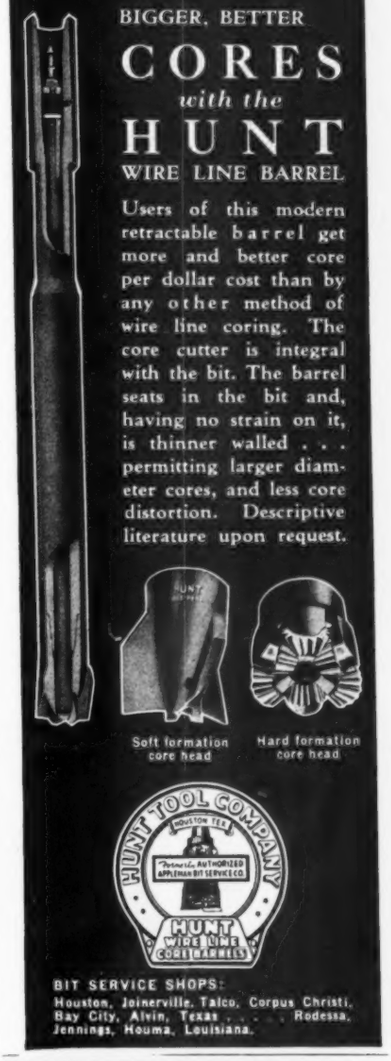
LESTER G. SCHRAUB

the United States, as well as in Canada, Mexico, South America, and the Orient.

Schraub brings to his new task a background of 23 years' experience in the steel and wire business. He served for 14 years with the Keystone Steel & Wire Company, of Peoria, Illinois, reaching the position of assistant sales manager, prior to assuming charge of wire division sales for the Sheffield Steel Corporation.

Titusville Iron Opens Tulsa Office

The Titusville Iron Works Company, Titusville, Pennsylvania, through their Mid-Continent representative, Lew Klein, announces the opening of their new office at 314 Thompson Building, Tulsa, Oklahoma. They also advise they have appointed two new distributors for Titusville products, The Bridgeport Machine Company and The United Supply and Manufacturing Company; and have in addition their old distributor, The International Supply Company.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CORES
with the
HUNT
WIRE LINE BARREL
Users of this modern retractable barrel get more and better core per dollar cost than by any other method of wire line coring. The core cutter is integral with the bit. The barrel seats in the bit and, having no strain on it, is thinner walled . . . permitting larger diameter cores, and less core distortion. Descriptive literature upon request.
Soft formation core head
Hard formation core head
HUNT TOOL COMPANY
HOUSTON TEX.
AUTHORIZED APPLEMAN BIT SERVICE CO.
HUNT WIRE LINE CORE BARRELS
BIT SERVICE SHOPS:
Houston, Joinerville, Talco, Corpus Christi, Bay City, Alvin, Texas . . . Rodessa, Jennings, Houma, Louisiana.

STRAIGHT TALK.... about CROOKED HOLES

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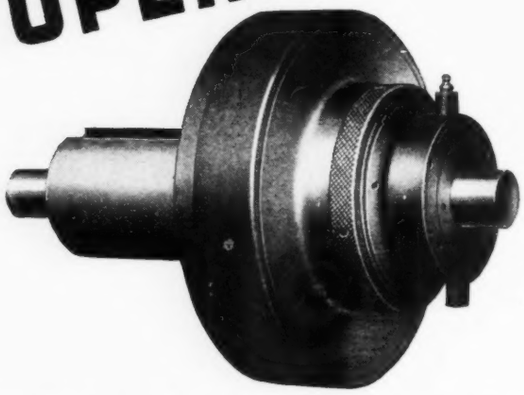
425 Petroleum Building, Tulsa, Okla.
3118 Blodgett Avenue, Houston, Texas
549 East Bixby Road (3800 Block—Atlantic Ave.) Long Beach, Calif.
Bank of Lafayette Bldg., Lafayette, La.
c/o Elks Club, 17th and I Streets, Bakersfield, Calif.

CAN *Absorb* THE SHOCKS OF CONTINUOUS OPERATION



In the oil fields—there are many times when equipment is subjected to terrific shocks . . . when power pressures test their capacities, often a fatal spot for clutches less rugged than Dodge Diamond "D" . . . Dodge Clutches are designed for normal or severe conditions . . . They are compact . . . rated to allow for 100% overload . . . have large friction areas . . . are completely enclosed insuring safety to workmen and full protection against dust and dirt.

Send for copy of Catalog No. A-200.

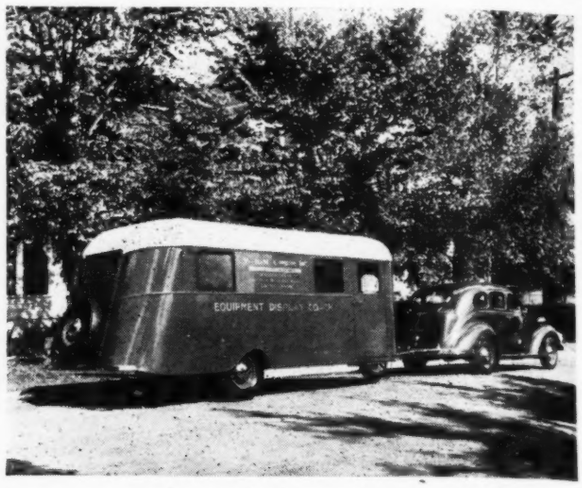
DODGE MANUFACTURING CORP.
Mishawaka, Indiana, U. S. A.

● *See the Dodge 20-page Section in the Oil Field Composite Catalog.* ●

DODGE
MISHAWAKA
THERE IS ADDED VALUE IN THE NAME DODGE

Traveling Display Presents Equipment to Men in the Field

Employing a specially-built trailer coach, the interior of which represents an equipment exhibit, W-K-M Company is taking its "oil exposition" to the man in the field. The novel arrangement, pictured here, left Houston recently for South Texas' active fields, and will continue from that district on a national tour of oil areas, presenting W-K-M products to customers and prospective users right on the job.



E. L. MacBlain, sales engineer for W-K-M Company, is in charge of the display coach, and will have the coöperation of W-K-M field men in their respective districts on the tour. The exhibit features practically every W-K-M product, either in actual working size, or in model where the tool itself would require too much space or be too heavy for traveling display purposes. One feature of the set-up is the presentation of W-K-M's Through-Conduit Lubricated Gate Valve in action, employing a vacuum arrangement to show how the valve cleans itself of debris with each operation. Another feature of the traveling display is that the coach is equipped with a motion picture projector and screen for the showing of motion pictures of interest to field men.

Open Office in Tulsa

The General Machine and Tool Company, having general offices in Wichita, Kansas, and operating oil-field supply stores and machine shops at various points in Kansas, have opened an office in Tulsa, Oklahoma. The location is 310 Thompson Building, and D. M. Hawkins is in charge.

Changes in Petreco Personnel

T. N. St. Hill, president of Petroleum Rectifying Company of California, announces several changes in the personnel of the company, which are effective immediately.

H. C. Eddy, chief engineer, who has a record of 24 years

H. C. EDDY

W. K. MELLON

of continuous service, has been elected a vice-president and director of the company. As vice-president he will be in full charge of all engineering activities.

W. K. Mellon, California district manager, with 18 years of continuous service to his credit, also has been elected a

WM. WOELFLIN

C. H. M. ROBERTS

vice-president, in which capacity he will have charge of sales and service in all territories.

Wm. Woelflin, who has served as research engineer in the company's laboratory at Long Beach, California, for the last six years, has been appointed district engineer for California with headquarters at Long Beach.

C. H. M. Roberts, who has been engaged in special research work for the company during the last 14 years, has been appointed research engineer in charge of the laboratory and research department at Long Beach, California.

Howard Supply Company New Firm

Oil country tubular products of Republic Steel Corporation, Cleveland, Ohio, are now being distributed on the West Coast through Howard Supply Company, Los Angeles, California, a newly-organized supply house. The new company is headed by Harold E. Howard as president, L. George Trembley, vice-president and sales manager, and Arthur Moyer, secretary and treasurer.

Howard formerly was associated with Ducommun Metals and Supply Company, and is widely known throughout Southern California. Trembley looks back on many years of selling experience in the California oil fields. Prior to joining Howard Supply Company he was manager of Ducommun's oil country division. Moyer has been associated with Ducommun for the last seven years in the capacity of assistant to Howard.

Two district sales managers have been appointed for the firm. Don Lucas will be the representative in San Joaquin Valley, a position he held with Ducommun during the past two years. Representative in the Los Angeles Basin Territory will be Earl Coval.

If you have bad SAND conditions

you will be well pleased with

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Tex Type

Working

Valves

They are ideal for common barrels. For insert pumps we recommend TEX TYPE Plunger Fittings. This valve is an assembly of a large number of Composition Rings separated by metal washers. It adapts itself readily to the tube in which it works. Tests prove that 5 to 13 per cent more fluid is pumped per hour during an exceptionally long life. Try them and you will be convinced.

Where Obtainable ?

Leading B-M-W Products are obtainable at supply stores:

● TEX TYPE Plunger Fittings and Valves; ● ADMORE Insert Pump Anchors; ● NEILSON Tools (Safety Sucker Rod Hooks, Tubing Hooks, Rod Elevators, Sucker Rod Sockets, etc.); ● BALLS and SEATS (made for every pumping service); ● ADMORE Liner Barrels; and ● COLLINS Belt Clamps.

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BRADFORD, PA. — TULSA, OKLA.

For

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and

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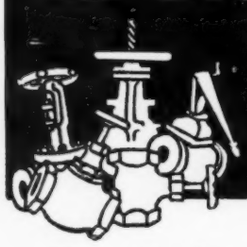
under High Pressure

You can handle pressures up to two thousand pounds under perfect control and pass on to your distributing lines whatever reduced pressure may be called for by use of the proper C-F Regulators. There are standard regulators for all pressures up to 600 pounds — for higher pressures designs are adapted to suit specifications.

The Chaplin-Fulton Mfg. Co.

28-40 Penn Avenue Pittsburgh, Penn.

Don't junk DIRTY VALVES



Don't junk valves ... or other fittings on equipment just because they're covered with heavy muck and grease. They're still worth money to you!

Salvage them the low-cost, easy Oakite way that so many other concerns are doing today. No scrubbing or scraping ... a short soak in a solution made up with recommended Oakite materials, a rinse and parts are clean, ready for inspection and necessary repairs. Send today for free booklet describing safe, economical methods for doing all types of producing or refining cleaning tasks. No obligation.

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- Quick dumping
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- Cleans and opens perforations
- Self-seating valve makes resetting unnecessary

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Send for Catalog

SHULL PERFORATING CO.

2750 Cherry Avenue, Long Beach, California

Dresser Establishes New Branch Offices

S. R. Dresser Manufacturing Company, Bradford, Pennsylvania, manufacturers of flexible pipe couplings and pipe-line repair devices, now have New York offices in the New York Central Building, 230 Park Avenue. J. K. Crowell, consulting gas engineer and eastern representative, will have headquarters at this new location.

J. K. CROWELL

A Chicago office also has been opened, in the Peoples Gas Building, 122 South Michigan Avenue. Chas. E. Norton is Chicago representative.

CHAS. E. NORTON

H. R. SHIDEL

Offices have been established in Houston also, in the Shell Building. H. R. Shidel, southwest oil-field representative, is in charge.

Pittsburgh Screw and Bolt Appoints Harry W. Schuetz, General Manager

The Pittsburgh Screw and Bolt Corporation has announced the appointment of Harry W. Schuetz as general manager of the Colona Division (manufacturers of pipe-thread protectors for oil country goods) succeeding the late Walter A. Clarke, who died October 24th from an acute heart attack.

HARRY W. SCHUETZ

Mr. Schuetz who has been associated with the company for a considerable number of years is widely known throughout the industry. He will continue his field work in the petroleum industry and contact pipe mills along with his new duties.

Pacific Enterprise Products, Inc., Open Tulsa Branch

Pacific Enterprise Products, Inc., Los Angeles, California, has opened a branch at 215 North Detroit Avenue, Tulsa, Oklahoma. J. H. Wallace, vice-president, is in charge.

The company handles the products of the Pacific Gear and Tool Works and the Enterprise Engine Corporation, both of San Francisco, and of the United Iron Works, Oakland.

Products of the Pacific Gear and Tool Works are gear units, which the company has manufactured for more than 30 years. The Enterprise Engine Corporation manufactures natural gas and Diesel engines, special vertical multi-cylinder engines for oil-field pumping, and vertical convertible Diesel engines for drilling. United Iron Works are pioneer manufacturers of centrifugal pumps. Much of this company's work has been to design special equipment for gasoline plants and refineries.

The Tulsa branch of Pacific Enterprise offers sales, engineering and service, and stock.

Changes in Caterpillar Personnel

Five important changes in the organization of Caterpillar Tractor Company have been announced by President B. C. Heacock. C. Parker Holt turns over the office of executive vice-president to A. T. Brown, formerly vice-president generally administering the accounting, treasury, traffic, and

A. T. BROWN

L. B. NEUMILLER

parts departments. Holt returns to the San Leandro, California, office of the company where, as vice-president, he will direct all "Caterpillar" activities in that territory.

L. B. Neumiller, formerly director of industrial relations, is now vice-president generally administering the parts, serv-

D. G. SHERWIN

D. A. ROBISON

ice, and traffic departments, as well as continuing active management of industrial relations. D. G. Sherwin has been advanced from treasurer to vice-president generally administering the advertising, sales, and treasury departments. D. A. Robison, formerly assistant treasurer, has been elected treasurer.

W. E. Palmer Resigns From National Supply

W. E. Palmer, manager in Tulsa of the tubular division of the National Supply Company, after more than 27 years' service, has resigned to become vice-president of the Southwest Supply Company of Pittsburgh and Bartlesville. He will remain in Tulsa and will maintain offices on the 19th floor of the Philtower Building.

M. D. "Max" Munder succeeds Palmer with the National Supply Company. Munder has been with the sales department of the company in Tulsa.

W. E. PALMER

Ask these questions about the **BALLS AND SEATS** *you buy!*

1. ARE THEY SURE TO BE TIGHT?
2. ARE THEY OF THE CORRECT HARDNESS?
3. WILL THEY GIVE ME LONG SERVICE?
4. WILL THEY MEET MY REQUIREMENTS?

Hough Specialized Balls and Seats check on every point! They're guaranteed tight; vacuum-tested; made from highest-grade metals; heat-treated in controlled furnaces. Seven specialized types—"Steelex," "Repelex," "Bronzex," "Resistex," "Combinex," "Utilex," and "Kamonex." In stock at your oil-field distributor's.

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Single Double or Three Sheave

CAPACITIES
Single Sheave 17½ Tons
Double Sheave 35 Tons
Three Sheave 50 Tons

Regan TUBING Blocks

Regan Tubing Blocks are built to the same principles of design and quality of workmanship and materials as offered in Regan Types 3B and 6-A Traveling Blocks. Made in two models. Model 1, heavy construction with streamlined cast steel guards. Model 2, lighter construction with fabricated plate guards. Sizes are 54-62 in both models. All equipped with roller bearings and chrome alloy steel sheaves. *Ask for Bulletin.*

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Forge & Engineering Co.

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San Pedro, Cal.
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Oklahoma—Mid-Co Tool & Supply Co., Oklahoma City.
Kansas Representative—Bovaird Supply Co., Wichita.
New York City Office—17 Battery. G. R. Woods, Mgr.

It was Ensign, founded twenty-five years ago, that first gave the power industry precision carburetting equipment of advanced design. Since its beginning Ensign has continually pioneered; and it still is pioneering, contantly seeking ways to improve its products—anticipating the needs of the industry which it serves—developing and manufacturing equipment the supremacy of which shall remain unchallenged.

Butane Equipment; Gasoline Carburetors for Industrial Engines and Tractors.

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CHICAGO . . TULSA . . HOUSTON

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PIPE LINES
Oil . . Gas . . Gasoline . . Water
CONSTRUCTION AND RECONDITIONING

●

APEX CONSTRUCTION COMPANY
HOUSTON, TEXAS

WILLIAMS BROTHERS & HAAS, INC.
SAN FRANCISCO, CALIF.

Trade Personals

F. H. PAYNE, president of American Meter Company, at a recent board meeting was elected also to be treasurer of the corporation, thereby filling the vacancy created in that office by the death of Donald McDonald. The vacant office of secretary was filled by the election of John Van Norden, formerly assistant secretary. He also was elected assistant treasurer, and will be in resident charge of the New York general offices at 60 East Forty-second street. He will continue his duties as manager of sales promotion.

●

A. J. PENICK, president of Oil Center Tool Company, is making a tour of the Illinois fields before returning to his headquarters at Houston, Texas, after attending the A.P.I. meeting in Chicago. He is accompanied by K. T. PENICK, secretary-treasurer of O.C.T.

●

WILLIAM R. SWEATT, chairman of the board of the Minneapolis-Honeywell Regulator Company, passed away recently.

●

ARTHUR T. COX, JR., has been appointed manager of Lincoln Electric Company's Tri-Cities welding sales-engineering office at Moline, Illinois. Cox formerly worked in the company's Chicago office.

●

J. A. SCHALLENBERG has been appointed assistant comptroller of Worthington Pump and Machinery Corporation, Harrison, New Jersey. Since 1930 he has served as special representative of the treasury and accounting departments, with headquarters in Paris, France, and while the affairs of the foreign subsidiary companies will continue to have his attention, the major portion of his time will now be devoted to the parent corporation.

●

CASSIUS F. BIGGERT, vice-president in charge of the International Harvester Company's iron and coal mines and Wisconsin Steel Works, retired as of November 1. He is succeeded by George E. Rose who has been Biggert's assistant since August, 1936, and has just been elected a vice-president.

●

FREDERICK D. BENZ, formerly manager wire sales, Chicago branch, Mechanical Goods Division, United States Rubber Products, Inc., has been appointed district manager of wire sales, Pacific Division, for the same company, with headquarters at San Francisco.

●

ROBERT BISCHOFF, hydraulic engineer, has been placed in charge of all valve engineering for Koppers Company's Western Gas Division, Fort Wayne, Indiana. Bischoff formerly was associated with the manufacture of hydraulic turbines in Switzerland.

●

ELLIS O. JONES, JR., of New York has been appointed to direct the safety activity of the Ethyl Gasoline Corporation on the West Coast with headquarters in Los Angeles. His field will be co-extensive with the corporation's Los Angeles division, which embraces California, Arizona, Idaho, Nevada, Oregon, Utah, and Washington, and of which S. M. Wagner is manager.

Death Takes P. C. Brooks, Fairbanks-Morse Executive

PERCY C. BROOKS

Percy C. Brooks, former executive vice-president of Fairbanks, Morse and Company, died at his home in Chicago October 15 after a lingering illness of about a year. He was 65 years old. In 1898 he began nearly 40 years' association with Fairbanks, Morse and Company, as assistant to the general manager at Beloit, Wisconsin.

C. B. Hinton Promoted By Bethlehem Steel Company

C. B. Hinton, for many years with the Williamsport Wire Rope Company, has been moved to Houston, Texas, to have charge of the wire rope and strand division office of Bethlehem Steel Company.

C. B. HINTON

Hinton, a former University of Arkansas "tall end," is well known in Texas oil circles, being stationed for several years in Dallas before being transferred to construction work along the Mississippi River. He takes the place in Houston made vacant by the transfer of Raymond Ford to have charge of the Chicago office of the same company. Hinton began his oil field experience back in Smackover, Arkansas, and has been with the one company since that date. His new territory will be Texas, New Mexico, and Louisiana.

L. L. Dimit, Petroleum Industry Pioneer, Passes Away

L. L. DIMIT

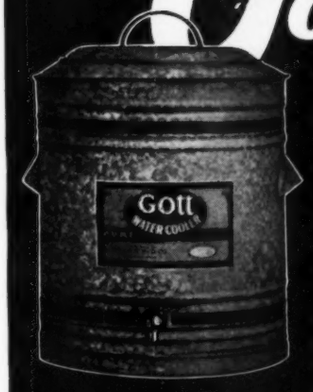
L. L. Dimit, a pioneer in the petroleum industry and the father of three sons who are prominent in the oil business, died a few days ago at his home in Neosho, Missouri. He was 86 years old and earlier this year he and his wife celebrated their 65th wedding anniversary. His three sons are C. P. Dimit, vice-president of Phillips Petroleum Company, Bartlesville, Oklahoma; W. H. Dimit of Fly, Ohio; and J. L. Dimit, with the Gulf Oil Corporation at Sapulpa, Oklahoma.

Iraq Petroleum Corp. Orders Three More Clark Compressors

Clark Brothers Company, Olean, New York, announce that the Iraq Petroleum Corporation has ordered three additional 300-hp. Clark balanced opposed electric-driven compressors for their crude stabilization plant at Kirkuk, Iraq. The first of these machines will start on its 8000-mile journey within the next few weeks.

Gotkool

WATER CANS & COOLERS



GOTT Water Coolers are the convenient way to keep drinking water handy to the worker, protect it from impurities. Their exclusive construction keeps water cool for long periods. Snug fitting large removable top, handy non-leaking push button faucet. GOTT Water Cans for handy field use. Your Supply Store has them, get one today!

GOTT WATER COOLER
Made in 3, 5, 8, 10, and 20 gallon sizes.

GOTT WATER CAN
Made in 1½, 3, 5, and 10 gallon sizes.

H. P. GOTT MFG. CO.
WINFIELD, KANSAS

KEEP PURE DRINKING WATER ALWAYS HANDY

Look for the *Arm-and-Hammer*

ARMSTRONG BROS.

Heavy Duty PIPE TONGS

Improved designs give these tongs greater strength and handiness. *Jaws* are drop forged from special steel; are heat treated, hardened and tested for wearing qualities. *Chains* are proof-tested to ⅔ catalog strength (3,600 to 40,000 lb.) *Handles*, forged from high carbon steel, have both stiffness and "spring." Drop forged Chrome-Nickel *Shackel*. Hardened *Bolt*. No finer tongs made. All sizes.

Improved
Standard Tongs
Reversible Jaw Tongs
Back-Up Tongs
Break-Out Tongs

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"The Tool Holder People"
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Electrical Sales Engineer

For Service in Foreign Oil Fields

Required immediately by large international organization: Services of a competent sales engineer thoroughly experienced in modern electrification methods used in oil fields. Must be able to originate specifications covering all electrical equipment right through power plant to well.

Write, giving complete qualifications, experience, references and photograph. Address Box "C", The Petroleum Engineer, Allen Bldg., Dallas, Texas.

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A WEED WILL GROW

IN A DAY

It takes 3 years

TO GROW AN

ORCHID!

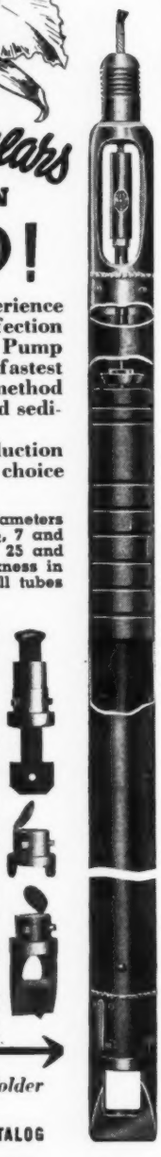
Over fifteen years' experience has gone into the perfection of the MILLER Sand Pump —the reason it is the fastest and most economical method of cleaning out sand and sediment from wells.

Increase your production with a MILLER—first choice throughout the world.

The MILLER is made in diameters of 2½, 3, 3½, 4, 4¼, 5, 5½, 7 and 9 inches and lengths of 20, 25 and 30 feet. 5/32-inch wall thickness in REGULAR Type, ¼-inch wall tubes HEAVY Type Sand Pumps.

INTERCHANGEABLE BOTTOMS

To Meet Every Condition



● BAILER BOTTOM

With the Bailer Bottom installed the MILLER is quickly changed to a Bailer giving you a combination of either Bailer or a Sand Pump in one tool.

● SAND BOTTOM

Used when tools are run and when well is shot to quickly remove loose material.

● STAR BOTTOM

Used for cutting the sand loose.

● CHISEL BOTTOM

(In Pump)

With this bottom tightly packed sand can be easily broken in small pieces so it can be picked up in the pump.

Write for Descriptive Folder and Price List

See Page 1186 COMPOSITE CATALOG

MILLER Sand Pump Co.

PATENTED
NO. 1370340
NO. 1523608
NO. 1787390
NO. 1862628
NO. 2656829
NO. 2055667

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A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT NO. 6

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*This index is revised monthly as additional tables are published.

(a) In footnote, "feet" should read "inches."

(b) Headings "Redwood No. 1 seconds" and "Redwood admiralty seconds" should be transposed.

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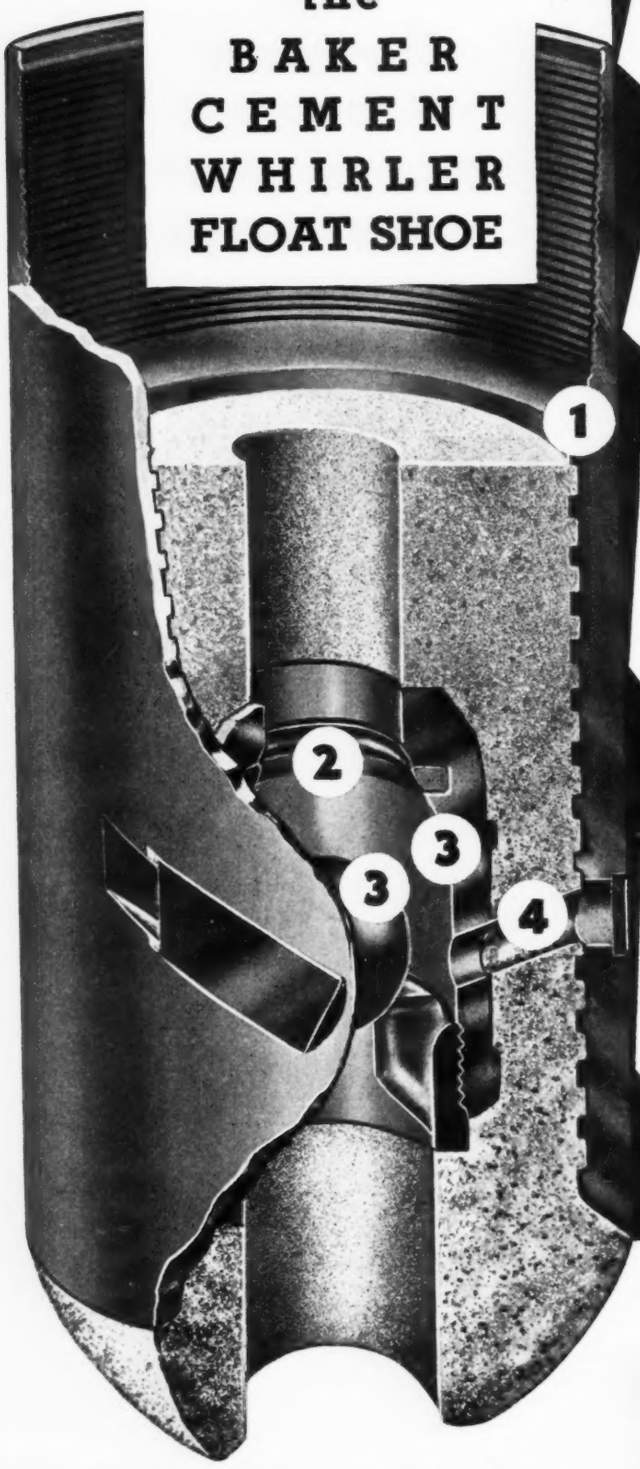
NET WEIGHT OF CASING, LB. PER 100 FT., FLOATED IN FLUIDS OF DIFFERENT DENSITIES

Casing size, O.D., in.	Weight, lb. per 100 ft.	Displacement, gal. per 100 ft.	Density of well fluid, lb. per gal.																		
			8½	9	9½	10	10½	11	11½	12	12½	13	13½	14	14½	15	15½	16	16½	17	17½	18
4¾	1600	92	817	771	725	679	633	587	541	495	449	403	357	311	265	219	173	127	81	35		
5	1300	102	433	382	331	280	229	178	127	76	25											
	1500		633	582	531	480	429	378	327	276	225	174	123	72	21							
	1800		933	882	831	780	729	678	627	576	525	474	423	372	321	270	219	168	117	66	15	
	2100		1233	1182	1131	1080	1029	978	927	876	825	774	723	672	621	570	519	468	417	366	315	264
5½	1400	123	351	289	228	166	104	42														
	1700		651	589	528	466	404	342	281	219	157	96	34									
	2000		951	889	828	766	704	642	581	519	457	396	334	272	210	149	87	25				
5¾	1400	135	253	186	118	51																
	1700		553	486	418	351	284	216	149	81	14											
	1950		803	736	668	601	534	466	399	331	264	196	129	61								
	2250		1103	1036	968	901	834	766	699	631	564	496	429	361	294	227	159	92	24			
6	2000	147	751	678	605	531	458	384	311	237	164	90	17									
6⅝	2000	179	478	388	299	209	120	30														
	2200		678	538	499	409	320	230	141	51												
	2400		878	788	699	609	520	430	341	251	162	72										
	2600		1078	988	899	809	720	630	541	451	362	272	183	93	3							
	2800		1278	1188	1099	1009	920	830	741	651	562	472	383	293	203	114	24					
7	1700	200																				
	2000		301	201	101	1																
	2200		501	401	301	201	101	1														
	2400		701	601	501	401	301	201	101	1												
	2600		901	801	701	601	501	401	301	201	101	1										
	2800		1101	1001	901	801	701	601	501	401	301	201	101	1								
	3000		1301	1201	1101	1001	901	801	701	601	501	401	301	201	101	1						
	4300		2601	2501	2401	2301	2201	2101	2001	1901	1801	1701	1601	1501	1401	1301	1201	1101	1001	901	801	701
7⅝	2640	237	624	505	387	268	149	31														
	2970		954	835	717	598	479	361	242	123	5											
	3370		1354	1235	1117	998	879	761	642	523	405	286	168	49								
8	2600	261	380	250	119																	
8⅝	2800	304	220	68																		
	3200		620	468	317	165	13															
	3600		1020	868	717	565	413	261	110													
	3800		1220	1068	917	765	613	461	310	158	6											
	4300		1720	1568	1417	1265	1113	961	810	658	506	354	203	51								
9	3400	330	591	326	260	95																
	3800		991	826	660	495	330	165														
	4000		1191	1026	860	695	530	365	199	34												
	4500		1691	1526	1360	1195	1030	865	699	534	369	204	39									

WHAT EVERY ENGINEER SHOULD KNOW ABOUT the BAKER CEMENT WHIRLER FLOAT SHOE



1 IT HAS STRENGTH . . . Note the strong construction of the seamless steel casing shoe. The entire unit is stronger than the collapsing strength of the casing upon which it is run—safe for strings of any length.

2 IT HAS EFFICIENT VALVE ACTION . . . Designed with buoyant Bakelite ball which floats in the rotary mud or cement slurry and instantly double-seals against a rubber ring (backed by Bakelite and Concrete) at the slightest reversal of pressure. HERE IS VALVE EFFICIENCY AT ITS BEST!

3 IT IS COMPLETELY DRILLABLE . . . Only Bakelite, Baker Formula-Concrete and a negligible amount of rubber are ever used in the internal construction of Baker Floating Units. These materials are easily drilled out, drilled up and circulated out of the hole, leaving no troublesome fragments to interfere with further drilling operations or coring immediately below the shoe. Note that the valve assembly is set on end to present a minimum amount of Bakelite to the drilling bit. Also that the passage through the valve chamber is ample to permit unrestricted circulation, yet small enough to retain an efficient wash-down action.

4 IT HAS WHIRLING ACTION . . . The Baker Cement Whirler Float Shoe is designed with a number of baffled side ports leading out of the valve chamber below the valve seat. When circulating prior to cementing, the fluid is directed outward through these ports and upward with a whirling motion which washes the formation and insures a better bond with the cement. When cementing, this whirling action affords a uniform distribution of cement around the shoe and for a maximum distance up and around the casing. The best possible cement job results with far less danger of channeling.

For Complete Details See the Baker Section of Your 1937 Composite Catalog

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BAKER CEMENT WHIRLER FLOAT SHOE

APPROXIMATE YIELD OF GASOLINE, PER CENT, STOCK CRACKED AT VARIOUS TEMPERATURES FOR VARIOUS LENGTHS OF TIME

Cracking time, seconds	Cracking temp., °F								
	820	860	900	920	940	960	1000	1050	1100
1								9	15
1.5							6	12	18
2							8	15	22
3						5	11	19	28
4						6	13	23	
5						8	15	26	
6					6	9	17	30	
7					6	10	19		
8					7	11	21		
9					8	12	22		
10				5	8	13	24		
15				7	11	17	31		
20			6	9	14	20			
30			8	12	18	26			
40			10	15	21	31			
50			11	17	24				
60			13	19	27				
70		5	14	21	30				
80		6	15	22					
90		7	17	24					
100		8	18	26					
150		10	23						
200		12	27						
300	6	16							
400	8	19							
500	9	22							
600	11	25							
700	12	27							
800	13	30							
900	14	32							
1000	15								

Users of this table should note particularly the effect of a small temperature increase on the time required to produce a given percent yield. For example, 90 seconds cracking is required to produce a 17 percent yield at 900 deg. fahr., but only 50 seconds is required at a temperature of 920 deg. fahrenheit.

Not all charging stocks will yield identical results under any given set of conditions. Refractory stocks must be cracked for a longer time to produce a given percent yield. Yields of all stocks, however, will be proportionate to that of the hypothetical stock for which the data are given. The choice of initial and end points of the product, as well as the nature of the charging stock, will affect the percent yield obtained under any set of conditions.

THERMAL

The use of THERMAL POLYMER Gasoline as a blending agent is rapidly increasing

The increased use of premium grade gasoline has made it very desirable for refiners and natural gas plant operators to have available a source of supply of superior blending gasoline.

Thermal Polymerization by utilizing by-product refinery gases, by-product natural gasoline plant gases or both, for making superior blending gasoline has proven an economical method of producing such stocks.

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POLYMERIZATION

A.P.I. DIMENSIONAL SPECIFICATIONS FOR BOLTED TANKS

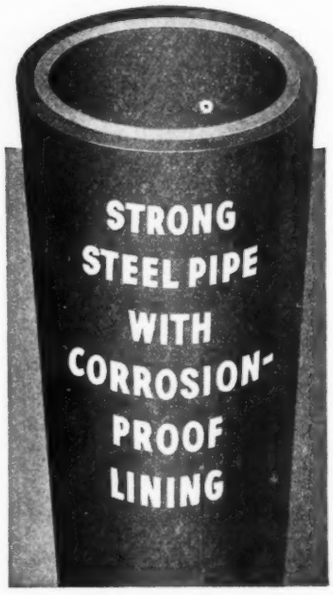
Capacity		Dimensions		Shell					Bottom		Water Seal Roof		Cone Roof		
Nominal capacity (42 gal. bbl.)	Actual capacity (42 gal. bbl.)	Inside diameter (nominal)	Roof and bottom bolt circle (diameter)	Height	No. stave per ring	U.S.S. gauge	No. of rows of bolts	Size of bolt	U.S.S. gauge	Size of bolt	U.S.S. gauge	Size of bolt	U.S.S. gauge	Size of bolt	
														Chime	Seam
100	95.80	9′- 2¾″	9′- 4¾″	8′-0½″	6	14	1	⅜″	14	⅜″	14	⅜″	14	⅜″	⅜″
200	191.64	9′- 2¾″	9′- 4¾″	16′-1″	6	14 14	1 1	⅜″ ⅜″	14	⅜″	14	⅜″	14	⅜″	⅜″
250	266.28	15′- 4⅝″	15′- 6⅝″	8′-0½″	10	12	1	½″	12	½″	12	½″	14	½″	⅜″
500 high	532.56	15′- 4⅝″	15′- 6⅝″	16′-1″	10	12 12	1 1	½″ ½″	12	½″	12	½″	14	½″	⅜″
500 low	522.01	21′- 6½″	21′- 8½″	8′-0½″	14	12	1	½″	12	½″	12	½″	14	½″	⅜″
1,000 high	1,044.02	21′- 6½″	21′- 8½″	16′-1″	14	12 12	1 1	½″ ½″	12	½″	12	½″	14	½″	⅜″
1,000 low	993.53	29′- 8⅝″	29′-10⅝″	8′-0½″	20	12	2	½″	12	½″	12	½″	14	½″	⅜″
2,000	1,987.06	29′- 8⅝″	29′-10⅝″	16′-1″	20	12 12	2 2	½″ ½″	12	½″	12	½″	14	½″	⅜″
5,000	5,037.45	38′- 7⅝″	38′- 9⅝″	24′-1½″	26	12 10 10	2 2 2	½″ ½″ ½″	10	½″	12	½″	14	½″	⅜″
10,000	10,218.49	54′-11¾″	55′- 1¾″	24′-2″	37	10 10 7	2 2 3	½″ ½″ ½″	10	½″	12	½″	14	½″	⅜″

So they bought DUROLINE
...and got both!

HERE'S real protection for your salt-water gathering and disposal lines. DUROLINE Pipe has a lining of dense, inert material which seals the pipe metal against the action of highly corrosive salt waters. Its tough steel sheath renders it practically immune to rough treatment, and its strong joints permit high working pressures.

Gathering and disposing of salt water is not an ordinary job for pipe. Salt well water is one of nature's most active corrosive agents — tends to attack plain pipe, causing needless expense and early replacement. At the same time, you need the strength of steel pipe and steel pipe joints—their ability to stand up under rough treatment, vibration, shocks, and high pressures. That's why you can't expect just any pipe to do this job, and do it well.

The cost of DUROLINE is only a few dollars a ton more than unlined pipe. Yet its useful life is usually three or more times longer. Write for a copy of the DUROLINE Bulletin.



NATIONAL TUBE COMPANY

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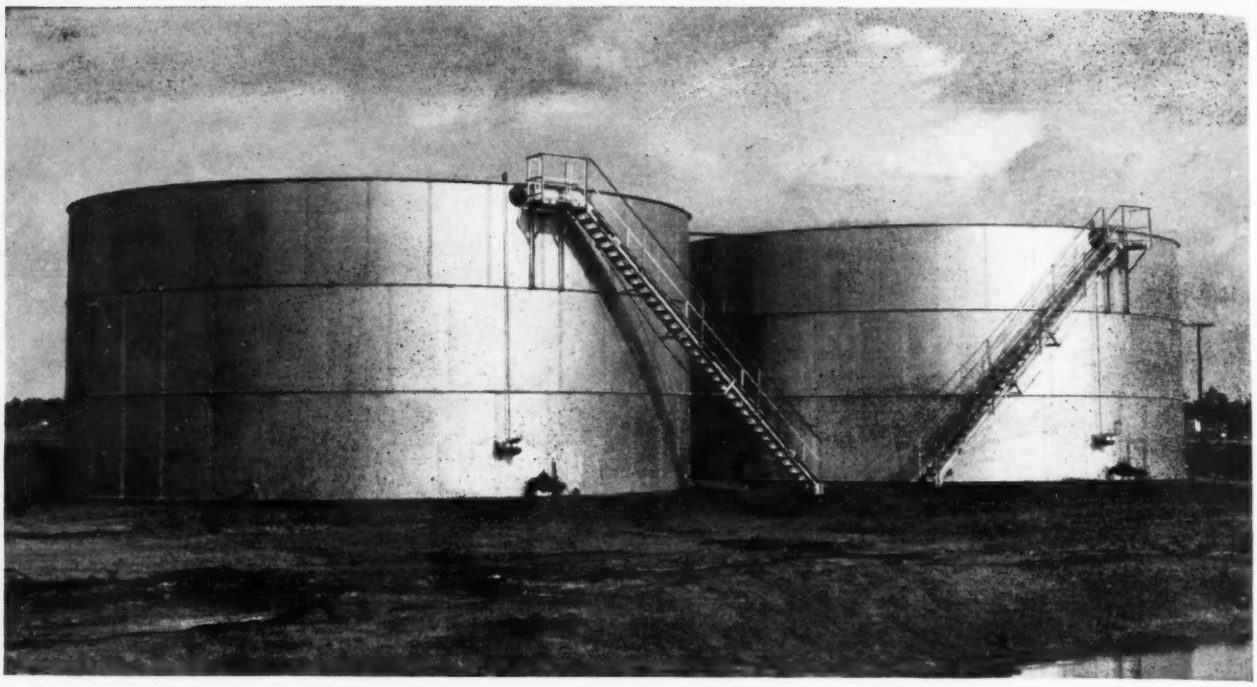
UNITED STATES STEEL

CAPACITY OF BOLTED STEEL TANKS, 42-GAL. BBL.

100 and 200 bbl. A. P. I. tanks						250 and high 500 bbl. A. P. I. tanks					
Ft.	In.	Gross	Net	Net less		Ft.	In.	Gross	Net	Net less	
			Gross less deadwood	2 percent	3 percent				Gross less deadwood	2 percent	3 percent
	1/16	.0621	.0620	.0608	.0602		1/16	.1725	.1724	.1690	.1672
	1/8	.1241	.1240	.1216	.1204		1/8	.3449	.3448	.3379	.3345
	3/16	.1862	.1861	.1824	.1805		3/16	.5174	.5173	.5070	.5017
	1/4	.2482	.2481	.2432	.2407		1/4	.6898	.6897	.6759	.6690
	5/16	.3103	.3102	.3040	.3009		5/16	.8623	.8621	.8449	.8362
	3/8	.3723	.3722	.3648	.3611		3/8	1.0348	1.0345	1.0138	1.0035
	7/16	.4344	.4343	.4256	.4212		7/16	1.2072	1.2069	1.1828	1.1707
	1/2	.4965	.4963	.4864	.4814		1/2	1.3797	1.3794	1.3518	1.3380
	9/16	.5585	.5583	.5472	.5416		9/16	1.5521	1.5518	1.5208	1.5052
	5/8	.6206	.6204	.6080	.6018		5/8	1.7246	1.7242	1.6897	1.6725
	11/16	.6826	.6824	.6688	.6619		11/16	1.8971	1.8966	1.8587	1.8397
	3/4	.7447	.7445	.7296	.7221		3/4	2.0695	2.0690	2.0276	2.0069
	13/16	.8068	.8065	.7904	.7823		13/16	2.2420	2.2415	2.1967	2.1743
	7/8	.8688	.8685	.8512	.8425		7/8	2.4144	2.4139	2.3656	2.3415
	15/16	.9309	.9306	.9120	.9027		15/16	2.5869	2.5863	2.5346	2.5087
	1	.9929	.9926	.9728	.9628		1	2.7594	2.7587	2.7035	2.6759
	2	1.9858	1.9852	1.9455	1.9257		2	5.5187	5.5174	5.4071	5.3519
	3	2.9788	2.9778	2.9183	2.8885		3	8.2781	8.2762	8.1107	8.0279
	4	3.9717	3.9704	3.8910	3.8513		4	11.0374	11.0349	10.8142	10.7039
	5	4.9646	4.9630	4.8638	4.8142		5	13.7968	13.7936	13.5177	13.3798
	6	5.9575	5.9556	5.8365	5.7770		6	16.5562	16.5523	16.2213	16.0557
	7	6.9505	6.9483	6.8093	6.7398		7	19.3155	19.3111	18.9249	18.7318
	8	7.9434	7.9409	7.7820	7.7026		8	22.0749	22.0698	21.6284	21.4077
	9	8.9363	8.9335	8.7548	8.6655		9	24.8343	24.8285	24.3319	24.0836
	10	9.9292	9.9261	9.7276	9.6283		10	27.5936	27.5872	27.0355	26.7596
	11	10.9222	10.9187	10.7003	10.5911		11	30.3530	30.3459	29.7390	29.4355
1		11.9151	11.9113	11.6731	11.5540	1		33.1123	33.1047	32.4426	32.1116
2		23.8302	23.8226	23.3461	23.1079	2		66.2247	66.2093	64.8851	64.2230
3		35.7453	35.3339	35.0192	34.6619	3		99.3370	99.3140	97.3277	96.3346
4		47.6604	45.6452	46.6923	46.2158	4		132.4494	132.4187	129.7703	128.4461
5		59.5754	59.5565	58.3654	57.7698	5		165.5617	165.5234	162.2129	160.5577
6		71.4905	71.4678	70.0384	69.3238	6		198.6740	198.6280	194.6554	192.6692
7		83.4056	83.3791	81.7115	80.8777	7		231.7864	231.7327	227.0980	224.7807
8		95.3207	95.2904	93.3846	92.4317	8		264.8987	264.8374	259.5407	256.8923
9		107.2358	107.2017	105.0577	103.9856	9		298.0110	297.9421	291.9833	289.0038
10		119.1509	119.1130	116.7307	115.5396	10		331.1234	331.0467	324.4258	321.1153
11		131.0660	131.0243	128.4038	127.0936	11		364.2357	364.1514	356.8684	353.2269
12		142.9811	142.9356	140.0769	138.6475	12		397.3481	397.2561	389.3110	385.3384
13		154.8962	154.8469	151.7500	150.2015	13		430.4604	430.3607	421.7535	417.4499
14		166.8113	166.7582	163.4230	161.7554	14		463.5727	463.4654	454.1961	449.5614
15		178.7263	178.6695	175.0961	173.3094	15		496.6851	496.5701	486.6387	481.6730
16		190.6414	190.5808	186.7692	184.8634	16		529.7974	529.6748	519.0813	513.7846



10,000-barrel Maloney Tanks, equipped with Maloney Stairways

WHY ENGINEERS ENDORSE MALONEY TANKS

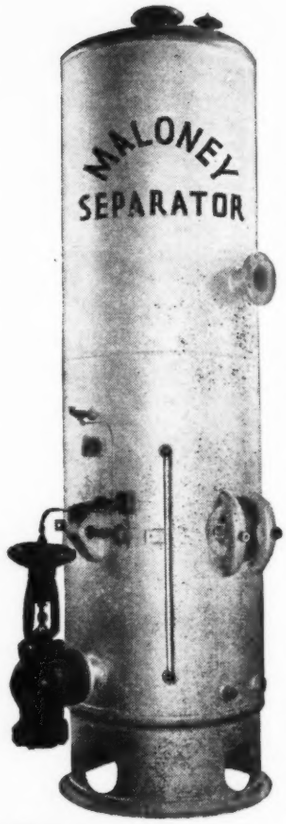
MALONEY Bolted Steel Tanks have a number of features which are highly endorsed by engineers. These features include: Construction of Blue Annealed Copper Steel, possessing 200 to 500 per cent greater resistance to corrosion than ordinary sheet steels ... MALONEY patented "Crimp" at all seams and joints, insuring accurate fit of parts without calking ... All seams reinforced with heavy steel channels which also keep bolt heads from turning ... Punched, cloth-inserted "MALONEY Red" Rubber Packing ... Bolts of 90,000 pounds tensile strength ... 30" x 48" flush Clean-out Plate, heavily reinforced on inside of tank and easily removed and replaced from outside of tank ... All-aluminum non-spark Vacuum Pressure Valve and Thief Hatch ... Tanks coated with special Red Chromated Iron Oxide primer and high-grade Aluminum finish coat ... Extra-Heavy galvanized tank coating by the "double-hot-dip" process, applied AFTER fabrication. ... A.P.I. standards. Capacities from 100 to 10,000 barrels.

MALONEY STAIRWAYS AND WALKWAYS

Engineers also like the features of MALONEY non-skid, self supporting, sectional steel Stairways and Walkways, which conform to the new A.P.I. specifications. By being built in interchangeable 4-, 6- and 8-foot units of 26-inch width, they are adaptable for any requirement. Walkways are set on heavy steel-angle brackets bolted to heavy steel-channel uprights, which in turn bolt to tank chimes. Three-quarter-inch steel cantilever turnbuckle rods give firm support to both Stairway and Walkway. Walkway units are welded at all corners, and cross supports are welded beneath tread every two feet. Either painted or galvanized coating.

MALONEY IMPROVED SEPARATOR

MALONEY has recently introduced a new Oil and Gas Separator which incorporates a number of improvements, including (1) Patented Mist Traps which separate all of the oil from the gas vapors, allowing only dry gas to escape through vent in top of separator; (2) Initial chamber of increased capacity, providing a higher vertical travel for vapors as they enter the new Knock-Out Element. A.P.I. and A.S.M.E. standards. Write for complete information.



See MALONEY *Section, Composite Catalogs*

MALONEY TANK MFG. COMPANY

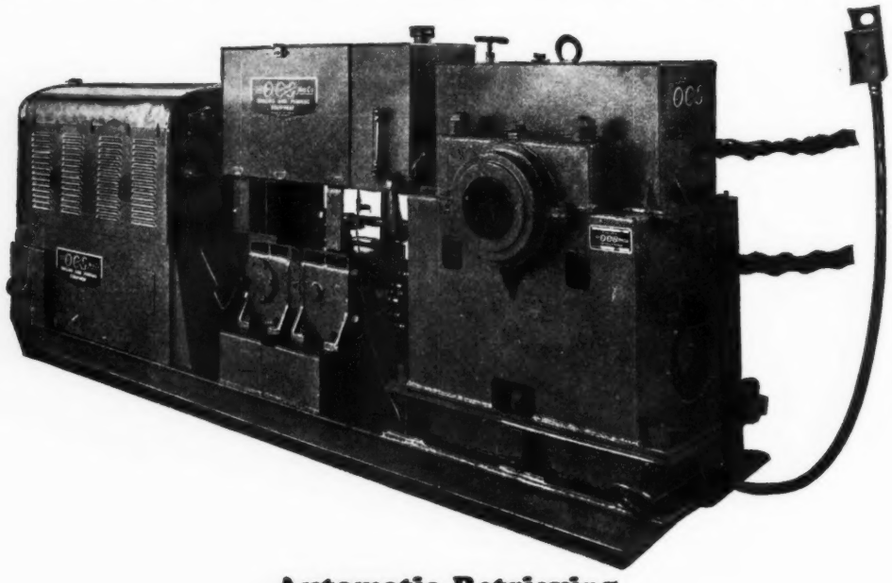
38 N. PEORIA TULSA, OKLAHOMA

MALONEY PATENTED BOLTED COPPER-STEEL TANKS

OIL RESERVES, BBL. PER ACRE FT.

Saturation, percent	Porosity, percent																	
	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
14	87	98	109	119	130	141	152	163	174	185	196	206	217	228	239	250	261	272
16	99	112	124	137	149	161	174	186	199	211	223	236	248	261	273	286	298	310
18	112	126	140	154	168	182	196	209	223	237	251	265	279	293	307	321	335	349
20	124	140	155	171	186	202	217	233	248	264	279	295	310	326	341	357	372	388
22	137	154	171	188	205	222	239	256	273	290	307	324	341	358	376	393	410	427
24	149	168	186	205	223	242	261	279	298	317	335	354	372	391	410	428	447	466
26	161	182	202	222	242	262	282	303	323	343	363	383	403	424	444	464	484	504
28	174	196	217	239	261	282	304	326	348	369	391	413	434	456	478	500	521	543
30	186	209	233	256	279	303	326	349	372	396	419	442	466	489	512	535	559	582
32	199	223	248	273	298	323	348	372	397	422	447	472	497	521	546	571	596	621
34	211	237	264	290	317	343	369	396	422	448	475	501	528	554	580	607	633	659
36	223	251	279	307	335	363	391	419	447	475	503	531	559	587	614	642	670	698
38	236	265	295	324	354	383	413	442	472	501	531	560	590	619	649	678	708	737
40	248	279	310	341	372	403	434	466	497	528	559	590	621	652	683	714	745	776
42	261	293	326	358	391	424	456	489	521	554	587	619	652	684	717	749	782	815
44	273	307	341	376	410	444	478	512	546	580	614	649	683	717	751	785	819	853
46	286	321	357	393	428	464	500	535	571	607	642	678	714	749	785	821	857	892
48	298	335	372	410	447	484	521	559	596	633	670	708	745	782	819	857	894	931
50	310	349	388	427	466	504	543	582	621	659	698	737	776	815	853	892	931	970
52	323	363	403	444	484	524	565	605	646	686	726	767	807	847	888	928	968	1009
54	335	377	419	461	503	545	587	628	670	712	754	796	838	880	922	964	1006	1047
56	348	391	434	478	521	565	608	652	695	739	782	826	869	912	956	999	1043	1086
58	360	405	450	495	540	585	630	675	720	765	810	855	900	945	990	1035	1080	1125
60	372	419	466	512	559	605	652	698	745	791	838	884	931	978	1024	1071	1117	1164
62	385	433	481	529	577	625	673	722	770	818	866	914	962	1010	1058	1106	1154	1203
64	397	447	497	546	596	646	695	745	794	844	894	943	993	1043	1092	1142	1192	1241
66	410	461	512	563	614	666	717	768	819	871	922	973	1024	1075	1127	1178	1229	1280
68	422	475	528	580	633	686	739	791	844	897	950	1002	1055	1108	1161	1213	1266	1319
70	434	489	543	597	652	706	760	815	869	923	978	1032	1086	1140	1195	1249	1303	1358
72	447	503	559	614	670	726	782	838	894	950	1006	1061	1117	1173	1229	1285	1341	1397
74	459	517	574	632	689	746	804	861	919	976	1033	1091	1148	1206	1263	1320	1378	1435
76	472	531	590	649	708	767	826	884	943	1002	1061	1120	1179	1238	1297	1356	1415	1474
78	484	545	605	666	726	787	847	908	968	1029	1089	1150	1210	1271	1331	1392	1452	1513
80	497	559	621	683	745	807	869	931	993	1055	1117	1179	1241	1303	1365	1428	1490	1552
82	509	573	636	700	763	827	891	954	1018	1082	1145	1209	1272	1336	1400	1463	1527	1590
84	521	587	652	717	782	847	912	978	1043	1108	1173	1238	1303	1369	1434	1499	1564	1629
86	534	601	667	734	801	867	934	1001	1068	1134	1201	1268	1334	1401	1468	1535	1601	1668
88	546	614	683	751	819	888	956	1024	1092	1161	1229	1297	1365	1434	1502	1570	1639	1707
90	559	628	698	768	838	908	978	1047	1117	1187	1257	1327	1397	1466	1536	1606	1676	1746
92	571	642	714	785	857	928	999	1071	1142	1213	1285	1356	1428	1499	1570	1642	1713	1784
94	583	656	729	802	875	948	1021	1094	1167	1240	1313	1386	1459	1532	1604	1677	1750	1823
96	596	670	745	819	894	968	1043	1117	1192	1266	1341	1415	1490	1564	1639	1713	1788	1862
98	608	684	760	836	912	988	1064	1140	1217	1293	1369	1445	1521	1597	1673	1749	1825	1901
100	621	698	776	853	931	1009	1086	1164	1241	1319	1397	1474	1552	1629	1707	1784	1862	1940

OCS *Now Offers*
AUTOMATIC DRILLING



Automatic Retrieving

FOR FASTER, STRAIGHTER HOLES

For drilling straighter holes with greater speed, the OCS Automatic Weight Control is a definite advance in rotary drilling operations. This device is an independent unit consisting of a V-8 power unit driving a self-locking worm gear through a variable speed, reversible hydraulic transmission.

Automatic operation is always under complete and instantaneous control of operator and can be switched to manual control. The mechanism in the control box, either manually or automatically, varies the speed or direction of the hydraulic transmission, which in turn controls the pipe through the self-locking worm gear and draw works.

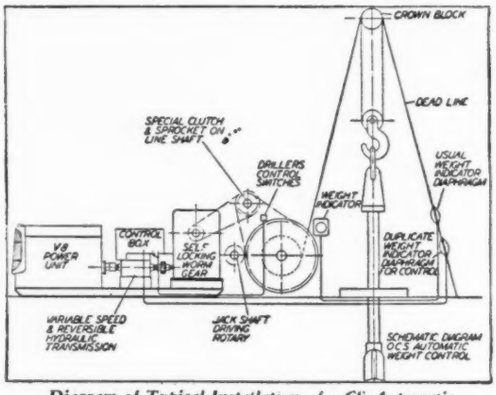
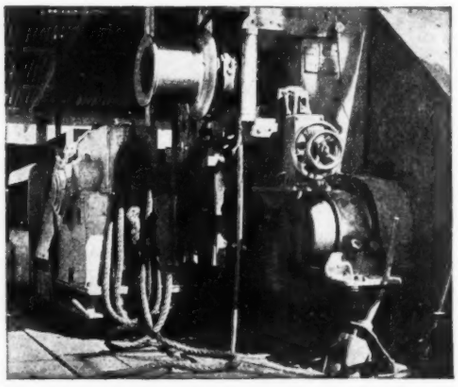


Diagram of Typical Installation of OCS Automatic Weight Control.



Illustrating the Location of the Automatic Weight Control in a Standard Rotary Drilling Rig

THE ADVANTAGES

More Speed
Straighter Holes
Continuous Feeding
More Hole Per Bit
Feeds Up as Well as Down
Helps Prevent Freezing Pipe
Recovers Better Cores
Faster Reaming

Write for Bulletin A.W.

THE OIL COUNTRY SPECIALTIES MFG. CO.

LONG BEACH, CALIFORNIA COFFEYVILLE, KANSAS HOUSTON, TEXAS

Sales Representatives in All Active Points in Mid-Continent and Hillman-Kelly, Incorporated, Los Angeles, California

PRESSURE REQUIRED TO PREVENT STORAGE EVAPORATION LOSSES, LB. PER SQ. IN. GAUGE

Reid vapor pressure	Maximum liquid surface temp., deg. fahr.				
	80	90	100	110	120
10.0	2.3	2.3	2.3	2.3	2.3
10.5	2.4	2.4	2.4	2.4	2.4
11.0	2.4	2.4	2.4	2.4	2.6
11.5	2.4	2.4	2.4	2.4	2.9
12.0	2.4	2.4	2.4	2.4	3.2
12.5	2.4	2.4	2.4	2.5	3.7
13.0	2.5	2.5	2.5	2.6	4.3
13.5	2.5	2.5	2.5	2.7	5.0
14.0	2.5	2.5	2.5	2.8	5.7
14.5	2.5	2.5	2.5	3.1	6.4
15.0	2.5	2.5	2.5	3.5	7.0
15.5	2.6	2.6	2.6	4.1	7.7
16.0	2.6	2.6	2.7	4.7	8.4
16.5	2.6	2.6	2.9	5.3	9.1
17.0	2.6	2.6	3.1	5.9	9.7
17.5	2.6	2.7	3.5	6.5	10.4
18.0	2.7	2.7	4.0	7.1	11.1
18.5	2.7	2.7	4.5	7.7	11.8
19.0	2.7	2.7	5.0	8.3	12.5
19.5	2.7	2.8	5.6	8.9	13.2
20.0	2.8	3.0	6.1	9.5	13.9
20.5	2.8	3.2	6.6	10.1	14.6
21.0	2.8	3.4	7.1	10.7	15.3
21.5	2.8	3.9	7.6	11.3	16.0
22.0	2.9	4.3	8.1	11.9	16.7
22.5	2.9	4.8	8.6	12.5	17.4
23.0	2.9	5.2	9.1	13.1	18.1
23.5	3.0	5.7	9.7	13.7	18.8
24.0	3.2	6.1	10.2	14.3	19.5
24.5	3.4	6.6	10.7	14.9	20.2
25.0	3.7	7.0	11.2	15.5	20.9
25.5	4.0	7.5	11.7	16.1	21.6
26.0	4.3	7.9	12.2	16.7	22.2
26.5	4.7	8.4	12.7	17.3	22.9
27.0	5.1	8.8	13.3	17.9	23.6
27.5	5.5	9.3	13.8	18.5	24.3
28.0	5.9	9.7	14.3	19.1	25.0
28.5	6.2	10.2	14.8	19.7	
29.0	6.6	10.6	15.3	20.3	
29.5	7.0	11.1	15.8	20.9	
30.0	7.3	11.5	16.3	21.5	
30.5	7.6	12.0	16.8	22.1	
31.0	8.0	12.4	17.3	22.7	
31.5	8.4	12.9	17.8	23.3	
32.0	8.7	13.3	18.3	23.9	

MASONEILAN REGULATORS

stay in the line

You buy regulators to *make* money for you —but a regulator in the repair shop *costs* you money. The wise purchaser selects equipment on which he can rely—which will do the job for which it is intended and keep on doing it year after year.

Correct design, highest quality materials and precision workmanship, backed by over half a century of practical experience, insure Masoneilan equipment staying in the line and out of the repair shop.

Specify Masoneilan Regulators for gas, oil, water or steam service under all operating conditions.

Write your requirements to our nearest office.

MASONEILAN

MASON-NEILAN REGULATOR COMPANY, 1193 ADAMS ST., BOSTON, MASS.

New York Philadelphia Pittsburgh Chicago Tulsa St. Louis Houston Los Angeles

CLEARANCE BETWEEN DRILL PIPE AND CASING, IN.

Casing size			Drill pipe diameter															
			2⅜-in.		2⅞-in.		3½-in.		4½-in.		5⅝-in.		6⅝-in.		7⅝-in.		8⅝-in.	
O.D., in.	Weight, lb. per ft. complete with couplings	I.D., in.	Pipe, 2.375	Coupling, 3.125	Pipe, 2.875	Coupling, 3.750	Pipe, 3.500	Coupling, 4.250	Pipe, 4.500	Coupling, 5.500	Pipe, 5.563	Coupling, 6.750	Pipe, 6.625	Coupling, 7.750	Pipe, 7.625	Coupling, 8.875	Pipe, 8.625	Coupling, 10.000
4¾	16.00	4.082	0.853	0.478	0.603	0.166												
5	13.00	4.494	1.059	0.684	0.809	0.372	0.497	0.122										
	15.00	4.408	1.016	0.641	0.766	0.329	0.454	0.079										
	18.00	4.276	0.950	0.575	0.700	0.263	0.388	0.013										
	21.00	4.154	0.889	0.514	0.639	0.202												
5½	14.00	5.012	1.318	0.943	1.068	0.631	0.756	0.381										
	17.00	4.892	1.258	0.878	1.008	0.571	0.696	0.321										
	20.00	4.778	1.201	0.826	0.951	0.514	0.639	0.264										
5¾	14.00	5.290	1.457	1.082	1.207	0.770	0.895	0.520										
	17.00	5.190	1.407	1.032	1.157	0.720	0.845	0.470										
	19.50	5.090	1.357	0.982	1.107	0.670	0.795	0.420										
	22.50	4.990	1.307	0.932	1.057	0.620	0.745	0.370										
6	20.00	5.352	1.488	1.113	1.238	0.801	0.926	0.551										
6⅝	20.00	6.049	1.837	1.462	1.587	1.149	1.274	0.899	0.774	0.274								
	22.00	5.989	1.807	1.432	1.557	1.119	1.244	0.869	0.744	0.244								
	24.00	5.921	1.773	1.398	1.523	1.085	1.210	0.835	0.710	0.210								
	26.00	5.855	1.740	1.365	1.490	1.052	1.177	0.802	0.677	0.177								
	28.00	5.791	1.708	1.333	1.458	1.020	1.145	0.770	0.645	0.145								
7	17.00	6.538	2.081	1.706	1.831	1.394	1.519	1.144	1.019	0.519								
	20.00	6.456	2.040	1.665	1.790	1.353	1.478	1.103	0.978	0.478								
	22.00	6.398	2.011	1.636	1.761	1.324	1.449	1.074	0.949	0.449								
	24.00	6.336	1.980	1.605	1.730	1.293	1.418	1.043	0.918	0.418								
	26.00	6.276	1.950	1.575	1.700	1.263	1.388	1.013	0.888	0.388								
	28.00	6.214	1.919	1.544	1.669	1.232	1.357	0.982	0.857	0.357								
	30.00	6.154	1.889	1.514	1.639	1.202	1.327	0.952	0.827	0.327								
	43.00	5.736	1.680	1.305	1.430	0.993	1.118	0.743	0.618	0.118								
7⅝	26.40	6.969	2.297	1.922	2.047	1.610	1.735	1.360	1.235	0.735	0.703	0.109						
	29.70	6.875	2.250	1.875	2.000	1.563	1.688	1.313	1.188	0.688	0.656	0.062						
	33.70	6.765	2.195	1.820	1.945	1.508	1.633	1.258	1.133	0.633	0.601	0.007						
8	26.00	7.386	2.505	2.130	2.255	1.818	1.943	1.568	1.443	0.943	0.911	0.317						
8⅛	28.00	7.485	2.555	2.180	2.305	1.868	1.993	1.618	1.493	0.993	0.961	0.367						
	32.00	7.385	2.505	2.130	2.255	1.818	1.943	1.568	1.443	0.943	0.911	0.317						
	35.50	7.285	2.455	2.080	2.205	1.768	1.893	1.518	1.393	0.893	0.861	0.267						
	39.50	7.185	2.405	2.030	2.155	1.718	1.843	1.468	1.343	0.843	0.811	0.217						
8⅝	28.00	8.017	2.821	2.446	2.571	2.134	2.259	1.884	1.759	1.259	1.227	0.633	0.696	0.133				
	32.00	7.921	2.773	2.398	2.523	2.086	2.211	1.836	1.711	1.211	1.179	0.585	0.648	0.085				
	36.00	7.825	2.725	2.350	2.475	2.038	2.163	1.788	1.663	1.163	1.131	0.537	0.600	0.037				
	38.00	7.775	2.700	2.325	2.450	2.013	2.138	1.763	1.638	1.138	1.106	0.512	0.575	0.012				
	43.00	7.651	2.638	2.263	2.388	1.951	2.076	1.701	1.576	1.076	1.044	0.450						

UNRETOUCHED PHOTOGRAPHS THAT SPEAK FOR THEMSELVES

The photograph above shows stands of drilling pipe used on a job in Corpus Christi. Note particularly the polished tool joints indicated by the arrows, worn smooth without Patterson-Ballagh Protectors. Note the tool joints on the pipe where protectors have been installed with wrench marks clearly discernible.

No metal is used in Patterson-Ballagh Protectors. None is necessary because the rubber is of special composition which retains its original strength and tenacity. This inherent resiliency of specially compounded rubber assures the protectors' retaining their original grip on the drill pipe. With the rotary mud serving as a lubricant, Patterson-Ballagh Protectors serve as bearings between tool joints and casing.

PATTERSON-BALLAGH CORP.

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At the left is a photograph of drilling pipe used in the Rodessa field of Louisiana. This pipe and protectors have just finished their seventh well with 14 months' continuous drilling . . . There is no loss in diameter nor change of position of the Patterson-Ballagh Protectors on the drill pipe.

PATTERSON-BALLAGH PROTECTORS